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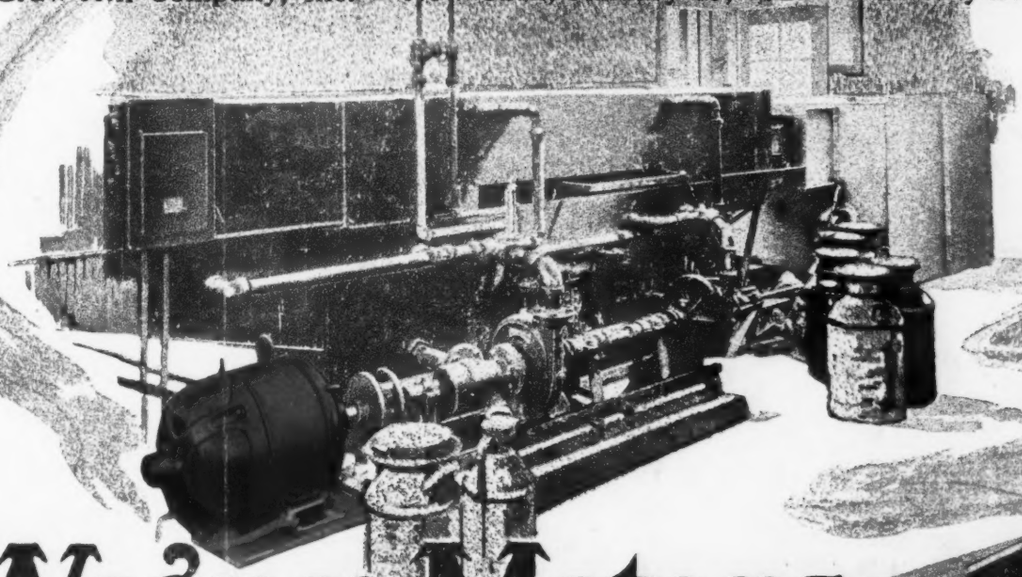

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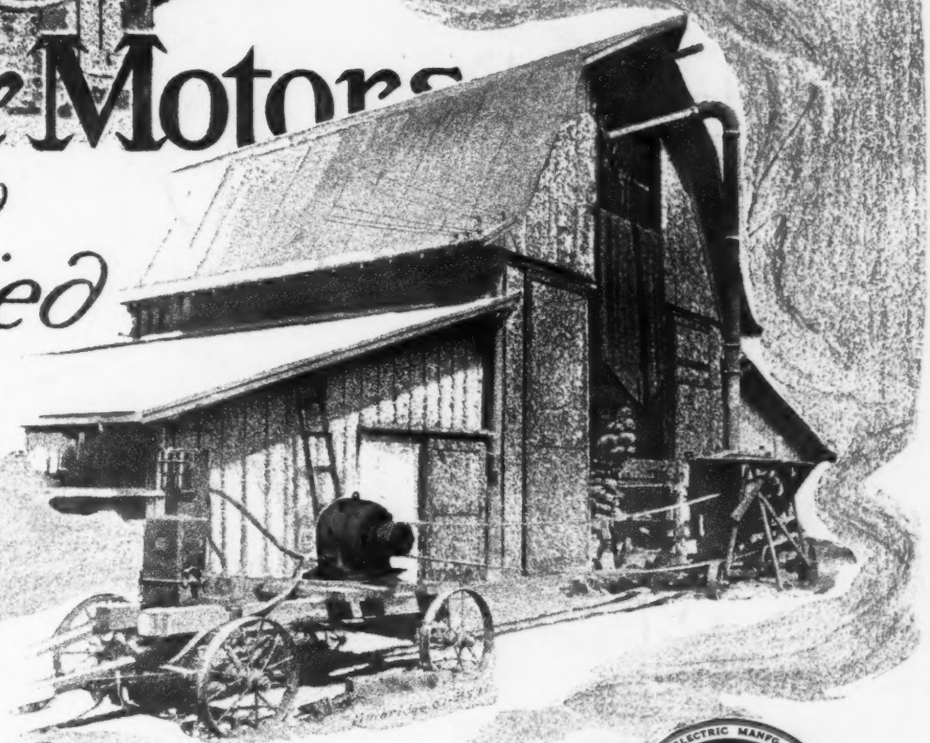

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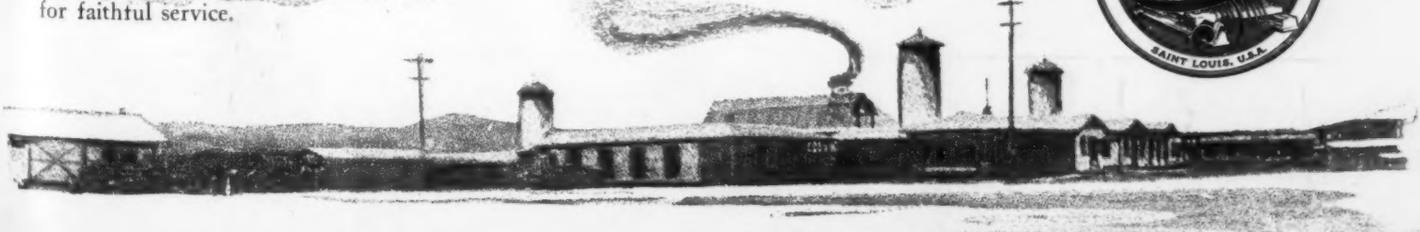

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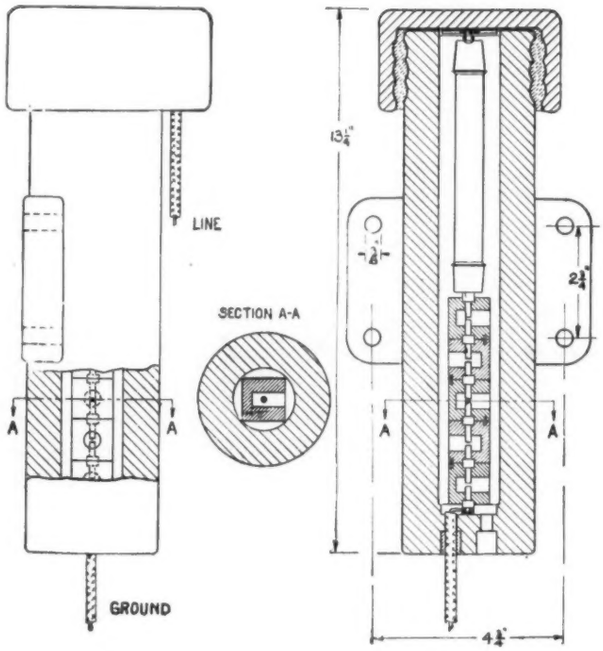

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Generous Foreign Credit Will Help Domestic Business

THE spirit of optimism, which knew no bounds when orders came in batches and one industry bid against another for labor and material, has in some quarters given place to a spirit of gloom. As a result production, the only remedy for most of the industrial ills of the world, has been restricted and a return to normal times has been retarded in the same degree. Because the farmer cannot now fix the price of next year's crop he refrains rather foolishly from planting cotton and grain, although no conservatively managed and essentially sound enterprise engaged in the production of a necessity need concern itself unduly about the adequacy of price. That is merely relative and in normal times is invariably reasonable. What is true of agriculture is true also of manufacture. In this country any restriction in output because our productive capacity is considerably above our normal consumption is unwise. The rest of the world not only needs our surplus but in the present crisis even asks, besides, to share in our superabundant home supply. Our own welfare and business prosperity depend to an appreciable extent on export trade, and we have an anomalous situation where Europe and the rest of the world are really begging us for material and foodstuffs but lack the ability to pay in gold. If, therefore, some adequate means of credit could be established, an immense foreign trade would immediately result. The exigencies call for a much greater amount of credit than that provided by the Foreign Trade Financing Corporation recently formed. Europe in its present chaotic and starving state is becoming a menace, and if her civilization means anything to the world, she must be helped. It is apparent that our credit system is not flexible enough to meet the emergency, but if each industry will paraphrase the Red Cross slogan and "Give credit till it hurts," a happy solution will be found.

The Backfire of Rate Increases

INCREASES in the rates paid for the service rendered by public utility corporations have not been a whit more popular than have other increases in the cost of living. Moreover, the very fact that the utility rates have been raised through the authority of and after investigation by the utility commissions has resulted in an antagonism toward these commissions by the same people who first demanded utility regulation. After fighting attempts of the commissions even to get at the facts necessary to render just decisions, the municipal authorities who vociferously inject themselves into the proceedings under the guise of "protecting the innocent consumers from the extortions of the bloodless corporations" claim that the commissioners favor the corporations when they allow them a return to cover the cost of doing business. Then comes a move to demand an end of regulation and a return of control to the municipal authorities. There are also demands that "political" appointments be made to fill forthcoming vacancies in some commissions. The really unfortunate thing is that the utilities cannot urge the continuance in office of able men who have shown wisdom in regulation. Their good faith would immediately be questioned and their ends defeated. However, there is yet hope in the fact that the tens of thousands of loyal employees of the utilities have it in their power convincingly to prove to their friends, and through them in an ever-widening circle to the whole public, that regulation is wise and must be sustained.

The Superman and the Average Man

AN ENCOURAGING philosophy is taught by Dr. C. P. Steinmetz, who is one among a group of engineers and industrial experts to whom is due the course in foremanship lately introduced into several hundred industrial establishments. Dr. Steinmetz's views on "incentive and initiative" were recently expressed by him through the New York *World*. "I am not a superman," he says. "I am not exceptionally qualified by nature for creative work. If we had a general recognition of the powers that exist in the human organism, and if we would organize our industrial machine so as to bring those powers into play, there is no reason why the average man might not accomplish at least as much as I accomplish. It is the function of the new leadership to release those powers and to give everybody his utmost opportunity." Supermen, as a matter of fact, are myths. Geniuses occasionally arise and in their moments of inspiration accomplish wonders, but they are far too erratic for reliance and often progress into insanity or degenerate into charlatanism. It is the man of average talent raised to the *n*th degree who counts, and raising one's talent to this degree is a matter of individual determination and perseverance, which are always responsive to and often dependent upon such leadership as Dr. Steinmetz champions.

A Time to Buy and to Produce

ACTION is more potent than theory or intent, and if the present depression in the business world is to be dispelled trade and not talk must be encouraged. It is idle to expect living costs to come down permanently unless production is increased, and with shops closed how can that condition be achieved? The time has come for the exercise of some common sense in the matter of buying. Of luxuries and non-essentials we have had our

fill and we need not concern ourselves with the fate of those who cater to extravagance. It is the essentials in which we are interested and in their constant and adequate supply. If these are priced unreasonably high, there must be a readjustment, but if not, their production should be encouraged. For instance, to cite concrete cases, copper is an essential metal and one greatly used in the electrical industry. The price of copper is now lower than it was at any time during the ten-year period before the war. We are not prone to giving commercial advice, but it is obvious that a thrifty manufacturer of electrical apparatus or a prudent electric light and power company manager would lay by a store of the red metal now. Cotton and aluminum have also come down in price, and since these materials too are used in the electrical industry advantage should be taken of this means of reducing the cost of apparatus still further. Nor are these by any means the only raw material used in electrical manufacture to which the reasoning applies. If there ever was a time for confidence in basic industries, it is now, and if there is any salvation in thrift, now is the time to put it into practice.

Power Distribution for Industrial Motors

A BRIEF paper by Fred Morgan in this issue gives an instructive study of several of the various types of distribution service for motors in industrial plants. The three types which he selects for investigation are the general radial system, with one switchboard and a feeder to each motor; the ring system, with a closed loop on which motors are cut in, and the compromise system of radial groups, in which the main supply feeds localized switchboards each with its radial group of motors. The case directly under notice is a thoroughly typical instance of about 1,000 hp. in two large factory buildings with a substation between them. Three-phase service at 60 cycles supplied from step-down transformers was assumed, and then careful estimates of all costs for motor voltages of 220 and 440 were made based on the three systems of installation. Obviously there are opportunities for varying and combining the three which might be practically advisable on account of special location of motors or by reason of grouping of buildings other than that described. For a comparatively simple instance like this, however, the results obtained are fairly comparable.

As worked out with all foreseeable items appropriate to the three cases included, Mr. Morgan finds the ring system of installation at 440 volts slightly the cheapest, followed closely by the radial group at the same voltage. A pure radial system does not seem well adapted for an installation of the area here considered, as might indeed have been foreseen. The advantage of the higher voltage is rather striking but somewhat less than a casual guess would indicate. It amounts on the average to somewhere around fifteen per cent, and of course the advisability of using 440 volts would depend very much on the character of the work to be done and the size and location of the motors with respect to the question of safety, which necessarily has to be considered in a 440-volt installation. Detailed estimates of this sort are not, of course, universally conclusive, but they have in this instance a good deal of practical value in that Mr. Morgan has made them on a somewhat typical installation estimated on a uniform and well-considered plan.

Progress in Relay Protection

PROGRESS in the application of automatic relays for circuit and network protection is admirably outlined in this issue by R. N. Conwell. The situation as it stands today is indicated, the various methods used here and in England are described, and the relative success of these methods is recorded. A warning is also issued not to build systems and then design their protection, but rather to design systems that can be effectively protected by simple means. Though perfect adjustment, great sensitiveness or even uncanny intelligence may be credited to relays even at this day, it is well not to expect too much of them. The result might be infinite complication, possible of adjustment it is true, but liable to serious trouble due to human shortcomings in installing, inspecting and operating.

The increased application of relays in central-station systems has been urged by us before. There are probably no companies that would not profit in a large measure by studying the possibilities of increasing such protection on their systems and making installations that would best suit their present conditions and be best adaptable to their future development. More accurate knowledge of their network, shorter interruptions, better service and savings in energy losses due to parallel operation of lines or better division of load would be certain rewards. We therefore feel that Mr. Conwell's contribution, in its authoritative and clear presentation, will inspire engineers to devote more energy to relay protection.

Rational Selection of Circuit Breakers

RAPID growth in size of central-station plants has emphasized circuit-breaker trouble and prompted the safeguarding of operation by the adoption of the most rugged switches. Experience, in fact, has shown that in some locations breakers with the highest possible rupturing ability are none too large. In the short article by H. L. Wallau in this issue attention is called to a phase in selection of circuit breakers that may not have received sufficient attention in the past. Mr. Wallau points out that there has been neglect in many places to take account of actual conditions, in forgetfulness of the fact that the voltage drops below normal under short-circuit current, and that consequently economy in the selection of circuit breakers has not been achieved. Aside from the size of the generating plant, the physical constants of equipment and the line, the determining factor in the selection of circuit breakers is the time setting of the relays for their automatic operation. It is therefore essential in selecting the breaker to know exactly the operating conditions to which it will be submitted when it takes its position in an extensive network. A slight reduction in time setting may result in overtaxing its current-rupturing ability. It would seem that often it would be more economical to plan the replacement of a breaker by a larger one when conditions demand it, rather than provide at first the extra capacity, which at best can only be arrived at by guesswork. The old axiom of the chain being as strong as its weakest link finds its application in this instance again and points to a design of circuit breakers in a system that will give approximately the same factor of safety at all points. Mr. Wallau provides means for arriving at this rational design.

Reducing Voltage Stresses in Transformer Coils

IN THE winding and assembling of the ordinary single-phase distributing transformer for reducing the pressure from 2,200 volts primary to 220 volts secondary, the maximum voltage that can be obtained between any pair of terminals by voltmeter is 2,420, when two appropriate terminals are brought into contact. The minimum voltage that can be obtained in this way is 1,980. The difference between maximum and minimum is not so great as to call for close attention to internal connections or groupings of coils. When, however, the primary pressure is, say, 66 kv. and the secondary 22 kv., their sum is 88 kv. and their difference 44 kv. These values are so different that it is worth while studying the internal connections of the transformer, with a view to minimizing the internal dielectric stresses in the event of a contact between primary and secondary conductors. The mode of assembling and connecting primary and secondary windings which promotes the development of the summation voltage, in case of a contact between conductors, is known as connection for additive polarity, and that which promotes the development of the difference voltage is termed connection for subtractive polarity.

C. W. Piper contributes an article in this number to the subject of subtractive or additive polarity for single-phase transformers. It is shown that the connection for subtractive polarity suffers no material disadvantage, while it offers the distinct advantage of minimizing the internal and external pressures which might be set up in consequence of an accidental contact between primary and secondary conductors.

Electrical Maintenance Must Not Be Neglected

BEFORE the superiority of electrical service was so thoroughly acknowledged in mining and manufacturing circles as it is today, the ruggedness of electrical apparatus was used by salesmen and engineers as an argument for the installation of motors and other electrical apparatus in preference to or in place of machines operated by other forms of power. When intelligently applied, electricity has done everything that was claimed for it and even more, but unless more attention is paid to the maintenance of electrical equipment than has generally been the case its reputation will suffer and its advocates will be disappointed.

The impression has been created in the minds of many industrial executives and master mechanics that so long as such details as oiling are attended to when necessary electrical apparatus can be virtually forgotten after it has been installed. Electrical engineers have been laughed at when they advised their companies not to change over from steam to electric service unless they were prepared to maintain the electrical apparatus properly by frequent inspections and cleaning. In one instance, which is typical of many, the electrical engineer's recommendations for maintenance were not carried out and his so-called pessimism is still thought to be groundless. The electrical applications were all well made, and the average age of the apparatus is only about four years; but during the next four or five years there will probably be regret that maintenance has been neglected.

Maintenance means keeping equipment in proper operating condition, not waiting for it to break down and then curtailing manufacturing production to restore service. Proper maintenance extends the useful life of electrical apparatus more than seems to be generally recognized. In one large factory with about 1,500 motors averaging 1.5 hp. the total cost of maintenance, including frequent inspection, oiling, renewing bearings, rewinding and so forth, is about $4 per motor horsepower per year. The cost of maintenance elsewhere will be affected by the distance apart and accessibility of the motors and by their average size, but it has been found that in nearly every case it is cheaper, all items considered, to keep motors in service by proper care and attention than to neglect them until they break down.

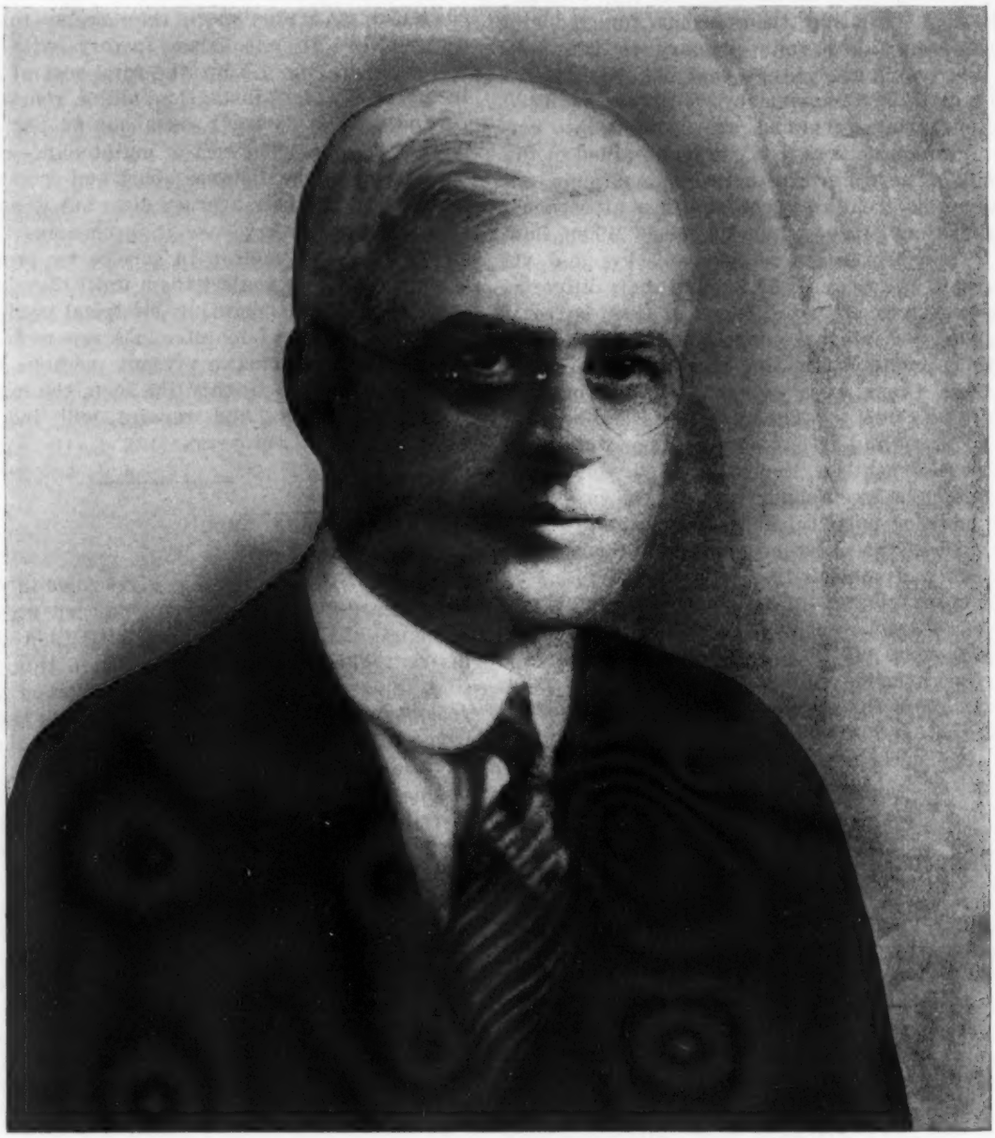
Every concern operating electrical equipment should give the subject of maintenance renewed consideration in an effort to improve present methods now. Unless action is taken along this line soon, the expense of electrical breakdowns and repairs will increase greatly during the next few years.

Rural Electricity Supply in England

A BRITISH contemporary gives some interesting facts regarding an experiment carried on at Hereford, England, for conveying electricity to a strictly rural district. The reason for the work in this instance was that the plant which had been installed there twenty years ago had never prospered owing to the small population (a little more than 20,000) and the absence of any considerable mechanical industries. To obtain business and put the plant on a sound basis a rural distribution was inaugurated, which, growing slowly at first, now covers a radius of 12 or 15 miles (20 or 25 km.) from the plant in all directions and supplies a steadily increasing number of customers.

The plant in its present state presents a good many points of interest. Its main equipment is 4,000 kw. in three turbo-units, delivering three-phase, 50-cycle energy at 3,300 volts. The supply in the center of the town is direct current, as was common practice when the plant was built, and the main outlying territory is served at present direct from the generators, the load being small and scattered, although the transmission system has been planned for 33,000 volts, with a view to further extensions, and the main distribution will soon be raised to 11,000. Cheap fuel in the unusual form of coke-oven dust eked out by oil has enabled the fuel cost to be cut far below any figure which could be reached with coal. The oil is used only at peak load, increasing the working capacity of the boilers by some 50 per cent. The transmission system for the main lines is lattice-girder steel poles, with wooden poles for low-tension distribution and services, such circuits being three-phase, four-wire, at 400 volts.

The result of all this activity has been a steadily increasing load of lighting, appliances and small motors for farm use, and this business has enabled the plant to show a clean profit beyond all fixed charges, including sinking fund, and to bring to a genuinely agricultural territory the full advantages of electric distribution. The point of the case is that under somewhat unfavorable circumstances, in a conservative farming community, electrical service has been extended to cover thoroughly a large area and that the enterprise has succeeded.



Walter Robbins

A prominent engineer-executive to whose efforts in securing for the government the whole-hearted co-operation of the electrical industry during the war can be attributed in no small measure the industry's splendid war performance

DURING the war one of the achievements of the electrical industry was its hearty and prompt response to every call of the government. This has been officially recognized by the government itself and also by numerous war industries whose outputs were so essential to modern warfare. Many things that had been talked of for years previously and accomplished under war conditions might still be the subject of frequent heated discussions except for the emergency that forced the experiment. Among those who gave their entire time to this work with marked credit to themselves and the industry was Walter Robbins, vice-president of the Wagner Electric Manufacturing Company, who served as chief of the electric power and equipment section of the War Industries Board from October, 1917, to December, 1918. His knowledge of the electrical productive capacity of the country made it possible to work out certain standardization of many devices through the elimination of a number of odd sizes and types. But greater than the result of bringing about this standardization was the masterly way in which he helped the electrical industry to serve the country during the war, so that the government was able to obtain all the electrical equipment needed in much quicker time than ordinarily. In meeting this unusual demand the orders were so distributed that regular production of apparatus for other purposes was not seriously affected. It was Mr. Robbins' department that saw to it that essential electrical equipment went to the place where it would count for most. His section took over complete control of turbine, boiler and other power-machine production schedules. In addition charge of the machine-tool, crane, brass and wire and cable sections was given to Mr. Robbins. As an indication of the volume of work that came under his supervision it is interesting to note that the electrical power and equipment section alone made recommendation to the priorities commission on approximately 30,000 applications.

Mr. Robbins was born in Marquette, Mich., March 8, 1875. His electrical engineering education was obtained at the University of Michigan, from which he was graduated in 1896. Prior to joining the Wagner organization in 1906 as assistant general manager, except for a year and a half with Pierce, Richardson & Neller, consulting engineers, he was employed by the Western Electric Company at Chicago, where he became superintendent of construction. He has continued a vice-president of the Wagner Electric Manufacturing Company ever since his election to that position in 1914.

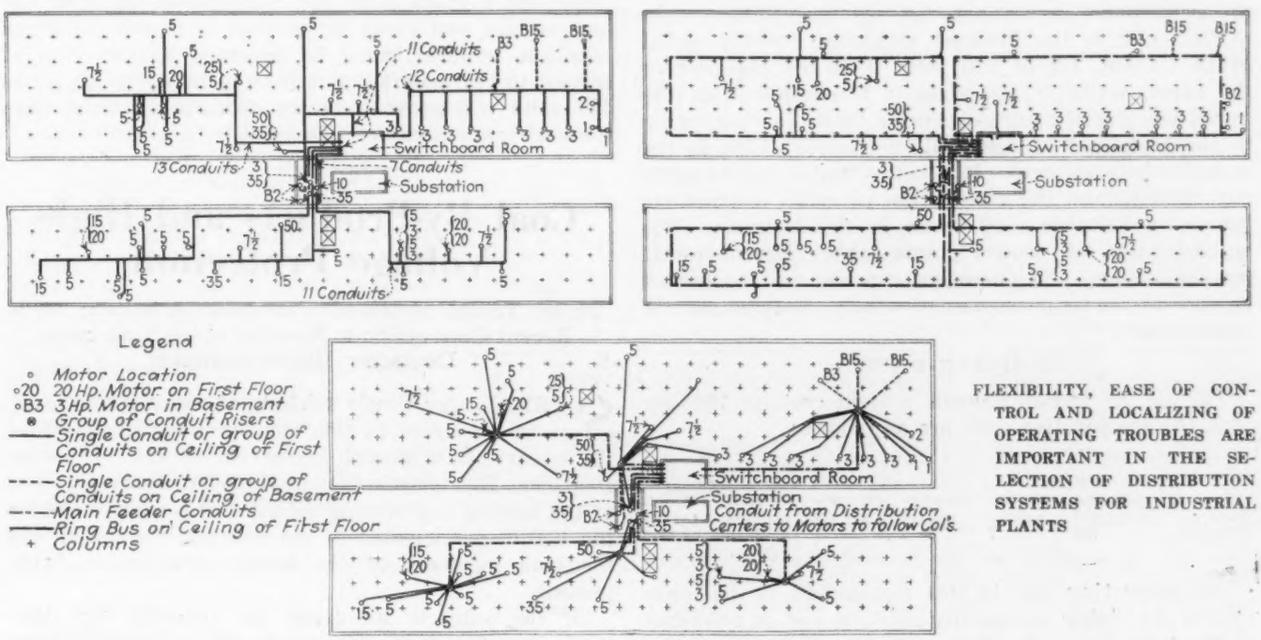
Industrial Distribution Methods Compared

Ring Feeder System Has Advantages Over Radial and Radial Group Systems—Radial Group and Ring Methods Compare Closely as to First Cost — Factors Influencing Choice

By FRED MORGAN
Engineer Sessions Engineering Company, Chicago

EXPERIENCE with numerous industrial distribution systems has shown three methods to be in common use, generally known as the "radial," the "ring" and the "radial group." The radial system consists of one feeder to each motor from the main switchboard. The ring system, as the name implies, consists of a closed loop feeding from the main source of supply and serving a certain group of motors. individual drive motors are distributed over large floor areas. Motor locations are the same in all cases.

The plant selected may be classed as an average industrial establishment, there being no processes that require special service. It consists of two buildings covering a total area of 240 ft. x 500 ft. (73 m. x 152 m.), with a substation in the center. Each building has a basement, first and second floors, with monitor



FLEXIBILITY, EASE OF CONTROL AND LOCALIZING OF OPERATING TROUBLES ARE IMPORTANT IN THE SELECTION OF DISTRIBUTION SYSTEMS FOR INDUSTRIAL PLANTS

The difference in the three general systems from the standpoint of wiring is clearly illustrated here. In the upper layout is shown the radial system, which has been the standard installation in earlier development and holds its place even today. Below is shown a radial-group layout, while on the right is the feeder-ring method of distribution. The ring system is the latest advance in distribution and offers interesting possibilities. These plans are for first floor and basement only.

The radial group consists of one large feeder from the main switchboard to a small distribution switchboard placed near the center of a group of motors from which single feeders run to each motor.

In order to draw a useful comparison between these three schemes of layout, types of apparatus have been selected which are commonly grouped together in each case. The estimates are based on present-day prices of material and labor with a contractor's profit of 15 per cent added. The results obtained will, of course, not be applicable at random to any specific layout, but will be valuable for comparative purposes as each system is designed to serve the same factory load and the unit prices are the same for the three cases throughout. This analysis does not consider the developments where any of these systems have been laid out in special cases to permit any desired shift of motors and equipment without wiring changes being necessary. It also does not consider the cases where large numbers of small roof. Construction is steel framework with brick walls and concrete floors.

The total connected motor load is 1,034 hp., typically distributed. Motor sizes range from 1 hp. to 50 hp. inclusive. Service is alternating current, three phase, 60 cycles, supplied from step-down transformers. Costs estimated include all switchboard apparatus, buses and lines from transformer buses to switchboard and motor feeders.

For all three systems the same load conditions and yearly power losses have been assumed. The same allowance (30 per cent) has been made in the main feeders in each case for future addition of load. All feeders consist of three single-conductor wires which are run in galvanized conduit. But voltages of 225 and 450 were assumed with a maximum drop of 5 per cent to any motor. Comparative costs and lists of equipment are given in the table which is shown at the bottom of page 246.

Reliability and flexibility rather than low first cost are the advantages claimed for the "radial" system, because of the individual handling of the motors. Automatic breakers mean that there are no fuses to blow and that there is less delay in restoring service when a breaker trips. By using conduit of a size greater than necessary motor feeders can be enlarged within reasonable limits without the cost of installing new conduit.

Reliability and flexibility as well as less first cost are features of the "ring" system. It possesses all the advantages of the "radial" system and in addition greater flexibility because of excess capacity in the "ring" and ability to relocate motors on the system. Oil switches on all incoming lines and at the motors increase reliability over the air-type breaker. Maintenance costs will be lower than with the radial system because of the use of oil switches in place of air-type breakers and the simplified feeder layout. Approximately 30 per cent less floor area will be required for the switchboard as against that for the radial system.

First cost is the greatest argument for the radial group system, for at 220 volts it is the cheapest of the three, while at 440 volts it is cheaper than the radial but slightly more expensive than the ring owing to the high cost of distribution boards, which is the same for both voltages. It is not so flexible as the other two systems and the installation of small distribution boards in valuable shop space is objectionable. The multiplication of control points makes an inherently weaker system, and operating expense will be higher because of the large number of widely scattered switchboard panels.

COMPARATIVE COSTS

Taking the radial 220-volt system cost as 100 per cent, the comparative costs are as follows:

	Radial		Ring		Radial Group	
	220 volts	440 volts	220 volts	440 volts	220 volts	440 volts
Total	$58,913	$48,704	$49,713	$42,898	$47,103	$43,757
Per cent	100	82.7	84.5	72.8	80.1	74.3

An interesting fact in this comparison is the lower cost of the higher voltage distribution, and on reference to the table below it will be seen that this is reflected in all cost items.

The costs per horsepower of connected motors for each scheme is as follows:

	220 Volts	440 Volts
Radial	$56.97	$47.10
Ring	48.08	41.49
Radial group	45.55	42.31

FACTORS INFLUENCING CHOICE

The factors influencing choice as between the various systems may be summarized as follows in the order of their relative importance:

	Radial	Ring	Radial Group
Reliability	2	1	3
First cost	3	1	2
Flexibility	2	1	3
Maintenance	2	1	3
Operation	2	1	3
Floor area for switchboards	2	1	3

For the average plant the ring system will give the best service and prove economical to install. Voltage selection, however, must be governed by the class of service to be rendered; but for the majority of plants 440 volts will prove a better operating voltage than the next lower pressure, 220 volts.

Coal By-Products and High-Voltage Protection

These Topics Received Particular Attention at a Recent Convention in Hanover of the Verbandes Deutscher Elektrotechniker

SEVERAL very timely subjects of considerable interest to engineers in this country were discussed at the twenty-sixth annual convention of the Verbandes Deutscher Elektrotechniker in Hanover, Germany. Ten of the leading engineering societies of Germany besides the V.D.E. participated in the meeting, more than one thousand members of the latter organization being present.

Of the subjects discussed the following are particularly interesting: Recovery of by-products from coal in power plants, mechanical removal of ashes; and

COMPARISON OF EQUIPMENT AND COSTS FOR RADIAL, RING AND RADIAL-GROUP SYSTEMS OF INDUSTRIAL DIS TRIBUTION

RADIAL SYSTEMS	RING SYSTEM	RADIAL-GROUP SYSTEM
SWITCHBOARD: Two three-section 40-in. by 12-ft. 10-in. slate panels with automatic circuit breakers and knife switches controlling incoming lines; tie switches and necessary meters; 112 19-in. by 22-in. slate panels, each with automatic air circuit breaker controlling one motor circuit; panels in tiers seven high and sixteen long.	Eleven 24-in. by 62-in. slate panels, two with automatic oil switches controlling incoming circuits; necessary meters; one panel for main indicating and recording meters, eight panels with automatic oil switches controlling ring feeders.	Thirteen 24-in. by 62-in. slate panels. Same as ring system with two extra panels for controlling radial feeders; ten panels for distribution switchboard made up of small slate panels, 19 in. by 22 in. each with an automatic air circuit breaker controlling one motor circuit; each board inclosed in wire mesh cage.
FEEDERS: One for each motor; minimum-size wire, No. 10; minimum-size conduit, 1¼ in. for 220 volts and 1½ in. for 440 volts.	Eight rings, each starting from oil switch and returning; wire one size throughout; branch boxes at points to provide for tapping in additional motors; to eliminate fuse branch motor-circuit conductors made same size as ring feeders.	Ten radial feeders, each controlled at main board by automatic oil switch and connecting directly to bus on distribution board.
MOTOR CONTROL: Compensator with no-voltage release.	Automatic oil switch with no-voltage release on line side of compensator.	Compensator with no-voltage release.

SUMMARY OF ESTIMATED COSTS

	220 Volts	440 Volts	220 Volts	440 Volts	220 Volts	440 Volts
Main switchboard	$30,097	$26,542	$14,480	$12,739	$15,868	$14,548
Oil switches at motors	.....	.....	13,408	13,408	.....	.....
Distribution switchboards	.....	.....	.....	.....	18,539	18,539
Wire and conduit	28,816	22,162	21,825	16,751	12,696	10,670
Total	$58,913	$48,704	$49,713	$42,898	$47,103	$43,757

protection against high voltages. The chief points of some of these outstanding papers are reported below.

The latest progress in the distillation of by-products from coal at power plants was outlined by Mr. Kreyssig, manager of a large generating plant. He explained that the process consists of drying, roasting or smoldering and distilling or gassing the bituminous coal. The drying should be done at temperatures from 120 deg. to 400 deg. C., and the smoldering is best accomplished between 400 deg. and 500 deg. C. In one of the systems which are in actual operation superheated steam is used to dry the soft coal in a small bunker situated above the smoldering drum. The steam escaping from the coal is then used in the gassing generator, thus avoiding loss of heat. The smoldering compartment of the gas generator has rectangular section similar to those of the well-known coke ovens for anthracite coal. The gassing compartment has a mechanically moved grate on which the fuel is fed uniformly.

The other system, built by Thyssen, consists of a slowly rotating horizontal drum, in which the drying and roasting of the coal take place, and a vertical, round-pit gas generator. The drum is heated from the outside, and a conveyor spiral transports the coal slowly through its full length, dumping the half-coke at its end into the generator. In the drum the coal gives off up to 90 per cent of the amount of tar which may be obtained from the coal in the laboratory. The economy of such a generating plant will, of course, depend not only upon the complete recovery of such by-products as tar and ammonia, but largely upon the heat efficiency of the process. The amount of heat necessary for the generation of one kilowatt-hour has been found to be:

	Heat Units per Kw.-Hr.
With steam turbines:	
1. Direct burning of the coal under boilers, without recovery of any by-products	5,400– 7,150
2. Coal distilled, but no by-products recovered, except gas for heating boilers	6,400– 8,500
3. Coal distilled and all by-products recovered; gas-heated boilers	9,500–12,000
Large gas engines:	
1. Coal distilled; use of excess heat under boilers; includes generation of gas; no by-products	4,200– 5,150
2. Same with recovery of tar	4,400– 5,450
3. Same with recovery of tar and ammonia	5,400– 7,150
Gas turbines:	
Includes gas generator and recovery of tar	4,300– 5,400
Diesel engines:	
Without usage of excess heat and cooling water	2,800– 3,400

After obtaining good results with a 1,000-hp. gas turbine, Thyssen is now building a gas turbine for 12,000 kw. The thermal efficiency of this gas turbine, including the gassing plant for the coal, is calculated to be 26 per cent, as against only 15-16 per cent with boilers and steam turbine. The Prussian Railways have placed an order for a 33,000-kw. gas turbine for the single-phase road from Magdeburg to Leipzig. Should the results be satisfactory, the gassing of bituminous coal on a large scale will be taken up on this road.

Another interesting discussion was led by Mr. Scholtes concerning the mechanical removal of ashes in large power stations. Six large stations had on their hands a combined amount of 527,000 metric tons of ashes, which required 600 men to remove by hand. By substituting mechanical means of removal 500 of these men have been released for other work. Mechanical removal is today of increased importance, because hand labor has increased tenfold in the last few years, Mr. Scholtes said.

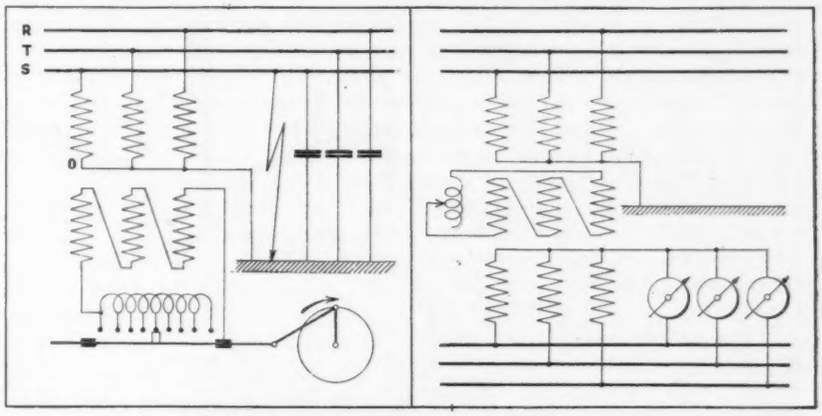
Requirements in Mechanical Removal of Ashes

The following requirements are essential:

1. The system should be fully automatic, requiring only supervision.

2. At night and on holidays it should be possible to shut down the conveyors without interrupting plant, in order to inspect or overhaul the apparatus. Sufficiently large bunkers should be available to store ashes for these periods of idleness.

3. The system should operate without producing dust. In case of trouble hand removal of ashes should be possible. Unskilled supervision should prove sufficient.



FIGS. 1 AND 2—TRANSFORMER ARRANGEMENTS FOR PREVENTING TEMPORARY GROUND FROM DEVELOPING INTO A PERMANENT ONE

Objection was raised to the third point on the grounds that stokers have to operate continuously and that therefore the ash-removal systems should also do so. Any accumulation of ashes is objectionable.

Replies to a circular letter sent to twenty-nine plants indicated four different ways of removing ashes—(a) Mechanically, (b) wet, (c) dry and wet, (d) pneumatically. With the mechanical method, which is especially used for anthracite fuel, the cinders are broken up and dumped onto endless belts or chains with buckets.

In the wet method water is used as a vehicle for ashes and slack, quenching the hot cinders at the same time. An interesting installation of this kind is at the coal mine Hibernia, in Westphalia, where twenty-two boilers discharge their ashes into a central trough. This is inclined from both ends toward the middle at a grade of 17 per cent, with 33 liters of water per second flowing from each end. By means of a pump the water is used over and over again.

On board of ships ashes are ejected by water and steam.

The pneumatic method is suitable only for pulverized fuel, the speaker said, because any ashes of larger size quickly eat through the mefal chutes.

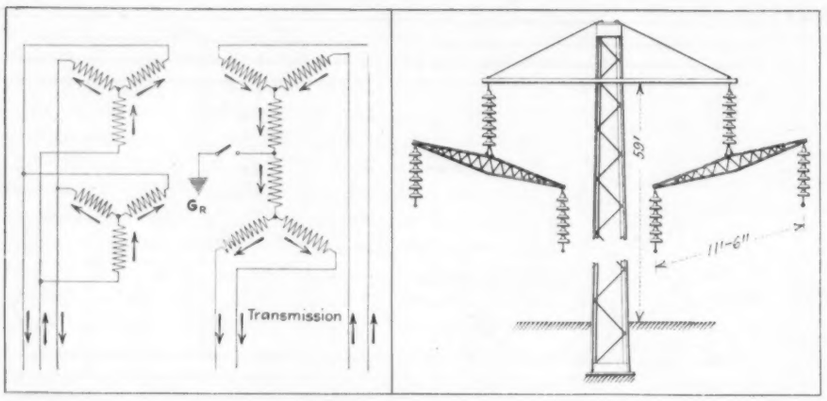
Protection Against Surges

"High-Voltage Protection and Safety of Electric Plants" was the subject of a paper presented by Prof. W. Petersen, in which he emphasized that, contrary to conditions in days gone by, when complicated and

non-homogeneous apparatus was used for protection, there is today a gratifying uniformity and simplicity of such protecting apparatus. Proper grounding, steep-wave-front protection for transformers and circuit breakers constitute the principal safeguards. For testing indoor insulators graded voltages are employed as follows:

Rating (Kv.)	Test Voltage in per Cent of Operating Voltage
Up to 12	500
Up to 35	300
Up to 50	260
Above 50	230

Considerable research and investigation have yet to be conducted to determine the proper internal insulation of transformers. Some plants specify such heavy insulation between adjacent coils as to make any outside protection like choke coils unnecessary. It may be possible that manufacturers will ultimately insulate even moderate and small sizes of transformers so well as to eliminate the necessity of external choke coils.



FIGS. 3 AND 4—TRANSFORMER AND LINE ARRANGEMENT FOR CHANGING A TWO-CIRCUIT, THREE-PHASE LINE TO A FOUR-WIRE LINE WITH INCREASED CARRYING CAPACITY

To assure the most reliable service, the speaker suggested test voltages for transformers as follows:

Rating (kv.)	Test Voltage in per Cent of Normal Voltage
10	375
24	250
110	200

Beginning at 10 kv. or 20 kv. operating voltage, the same simple protective apparatus as for highest voltages should be used; that is, ground protection, choke coils and protective circuit breakers. Ample protection against excessive ground currents is given by use of the so-called grounding coil. On lines with moderate voltage it is not recommended that a ground cut-out be employed. Such lines should be built sufficiently strong and safe to maintain operation even during a ground. Using ground detectors at both ends of the lines, it is easily possible to locate, separate and remove such a ground.

Interesting details of the so-called quenching transformer (Lösch-transformator) were given by Chief Engineer Schrottke. The apparatus prevents a temporary ground from developing into a permanent ground. It consists of an ordinary Y-open-delta transformer, the Y-point of the primary being grounded and the secondary delta being closed by a regulating reactance coil (see Fig. 1). It will be seen that if a ground occurs on one of the lines, for example *S*, the branch *SO* will be more or less short-circuited, causing a flow of current in the secondary which the primary derives from the line. This current may be so regulated by the reactance coil as to be equivalent to the charge current of the line to ground. The ground is thus deflected from the grounded line, and the line *S* is brought to the potential of ground, obviating any arc between line and ground. Any station transformer may be used as a quenching transformer by equipping it with a tertiary winding, as shown in Fig. 2.

Some large transmission problems were considered by chief engineer Tröger (A.E.G.). A total of 4,000 km. of line is operated today in Germany at 100,000 volts. Of this 1,200 km. have aluminum conductors, 2,400 km. have copper and 400 km. have aluminum-steel. The opinion is quite prevalent that the three-phase system requires the least amount of material. However, at the same current density and the same voltage to neutral all symmetrical systems, including the single-phase, require the same total cross-section for a given capacity. With the same insulation, dead-grounded systems permit of an increase of voltage in the ratio of the Y-voltage to the phase voltage, and therefore permit for the same capacity the use of a somewhat smaller conductor. Provided the wires have sufficient distance between them, a dead-grounded 100-kv. line may be operated at 173 kv. A similar result, without increasing the voltage between adjacent wires, may be obtained, according to Fig. 3, by connecting two three-phase circuits (transformers) together and grounding the connecting line, which results in four outgoing lines. Such a line transmitted before the grounding connection was made (with therefore six conductors) $2 \times \sqrt{3} \times 100 = 346$ kw. per ampere. After the connection with four conductors and the same current it transmitted $4 \times 100 = 400$ kw. This represents an increased capacity of 1 to 1.73. Of course, one disadvantage is that each ground is a short circuit. By using a suspension tower, as shown in Fig. 4, this quadruple line may be installed with the same number of insulators as the ungrounded system of six conductors.

In the discussion of this paper Professor Petersen expressed the opinion that the three-phase system is by no means the ideal one. At a cost of 60 to 70 per cent, with fewer towers, less installation and a higher safety factor, a single-phase system has the same transmission capacity. A system with constant voltage was not, in his opinion, the best solution of the transmission problem. A transmission line on which the voltage is adjusted so that at each lead the relation between current and voltage is definite (equal to the wave resistance) operates like a direct-current line and is far superior economically to a three-phase line.

Dr. Stern of the Allgemeine Elektricitäts-Gesellschaft expressed an opinion against aluminum-cell arresters, saying that they would operate satisfactorily if it were possible to connect them directly to the line. However, it is not possible, for chemical reasons. Aluminum cells when connected to the line via a spark gap constitute a wonderful generator of traveling waves.

Simplifying Electric Meter Maintenance

One Type of Demand Meter Should Be Chosen for Given Class of Service Wherever Possible—Selection of Standardizing Equipment and Frequency of Tests Are Also Dealt With—Measures for Making Meter Installations Safe

By J. C. LANGDELL
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ON ACCOUNT of the fact that metermen who actually maintain the demand meters on a system can master the characteristics of one meter more readily than those of several meters it is advisable for central-station companies to adopt a single type for any given class of service wherever possible. Meter installations should also be standardized and made safe so that there will be no risk to persons or to property. Meter service cabinets for enclosing live parts at the customers' premises and adequate grounding of secondaries are essential safety measures. Under favorable conditions the periods between tests of meters may be increased beyond those commonly adopted. Meter clocks, in particular, should be repaired or adjusted only by factory experts.

Accuracy of electric meters is a factor in the utility business of first importance and has a direct bearing on all of its incomes. Unfortunately no device for registering energy has yet been developed that will remain accurate indefinitely. The general tendency is to under-register owing to the wear of bearings. A satisfactory frequency of tests depends upon several factors; namely, income derived from the meter, type, age, location and periodic accuracy performance. Roughly speaking, the minimum time-interval test of alternating-current residence meters should be about thirty months, which can be extended to forty-eight months if the accuracy is adequate. A further extension may be permissible for the modern house-type meter, provided that the accuracy report shows the performance to be satisfactory. Old-time types of meters require more close supervision than modern types, and in extending the schedule it will be necessary to consider the performance of these meters. We have found by experience that direct-current and alternating-current meters of large capacity require testing in some cases at monthly intervals, in others less frequently, down to intervals of a year, on account of the large amount of revenue involved and the loss that would result should errors occur. One of the most important details of proper meter operation depends entirely upon the attention which the meter tester gives the meter in making his periodic test and inspection; that is, he should if possible determine the cause of inaccuracy and not make adjustments unless it is impossible to eliminate the cause of the error. It is of little use to recalibrate a meter which is found inaccurate because of excessive friction unless the cause is removed. The use of a much lighter moving element on the modern meter has added considerably to its life and reduced the wear of the moving parts.

Standardizing Primary Meter Installations

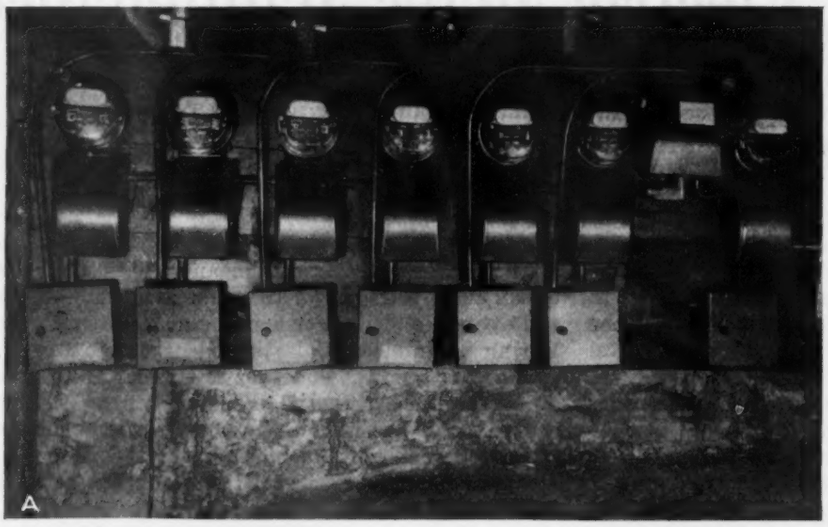
Practically all large power customers, those using 100 kw. and over, are metered on the primary side of the power transformers, both as to watt-hour and demand, by the Consumers' Power Company. Standard specifications have been made for the suitable housing of current and potential transformers and necessary meters. Wiring diagrams are also included, and so far as possible it has been the endeavor to standardize on the use of current and potential transformers as well as on demand and watt-hour meters. These installations are inspected weekly by an employee of the meter department, who makes a careful test as to the satisfactory operation of the meters, winds the clock, installs a new chart and tests the potential fuses, also inspecting the meter for rotation of both elements. A careful electrical test is made every six months by the use of a phantom load, and in addition a meter is tested on the customer's operating load. All of these installations are equipped with special testing blocks, and lamps are placed on the potential wires in order to detect quickly any trouble with the fuses.

Since many of these installations are subject to atmospheric conditions it has been necessary to arrange for the use of thermostatic devices in order that the even temperature so necessary to good clock operation may be maintained. The company at the present time is using almost universally the type G-2 demand meter, which is provided with a temperature device, the operation being entirely automatic. It has been the practice to use lamps in series with this device, but in view of difficulty due to its change with age it is planned to use a Ward Leonard resistor, which should operate more satisfactorily. An even temperature in connection with the G-2 type of demand meter is necessary because wax charts are used, which become hard under low temperatures, the result being a poor record.

One Type of Demand Meter Is Used

The selection of proper demand meters is most important, and in view of past experiences the use of type G-2 has been virtually standardized, principally on account of the elimination of ink difficulties and because of low maintenance costs. These meters can be used, moreover, with the same degree of accuracy on either constant or fluctuating loads. The G-2 chart is very easy to explain to the customer as the demand is clear and can be filed readily. Explaining to the customer the use of the curve-drawing wattmeter chart in obtaining demands has caused us considerable trouble, especially where fluctuating loads are concerned. In adopting this type of demand meter for general use in preference to the indicating type, such as the M-4, it was felt that trouble would be experienced in the operation of any demand meter. It has been exceedingly difficult to determine the cause of inoperation of the indicating type, a condition which does not occur with the type having a graphic chart; that is, it is assumed in using any demand time-interval device that it will not always function properly, and to remedy these troubles just what happened must

Some Examples of Good Meter Installations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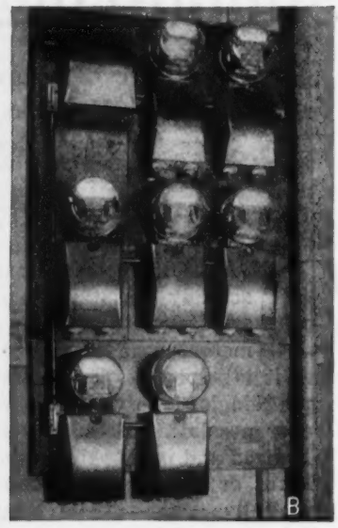
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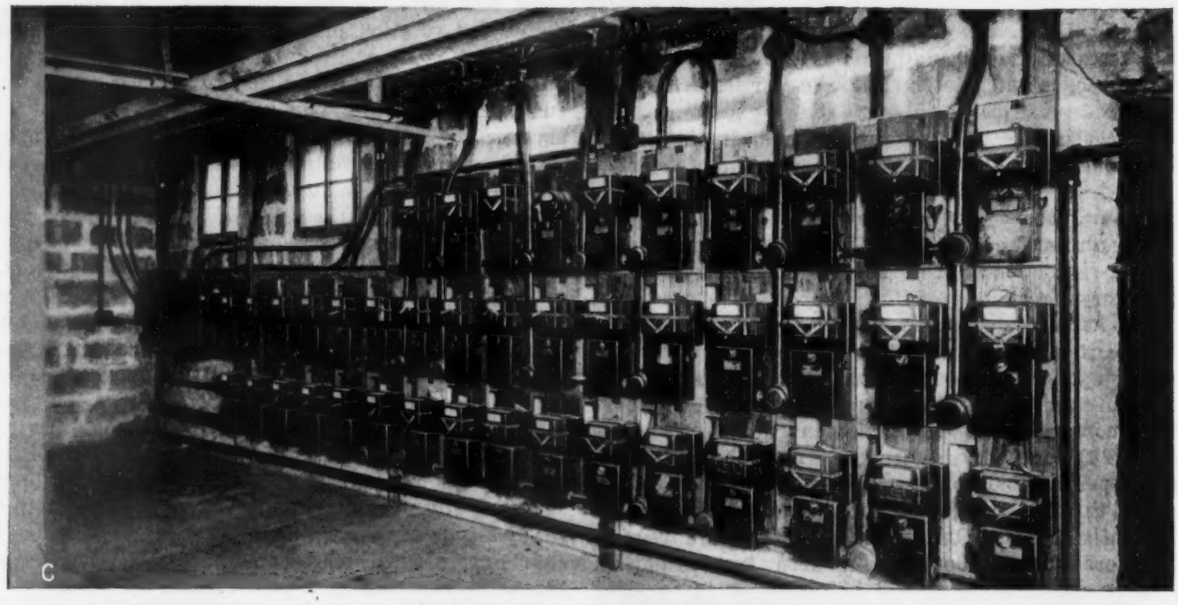
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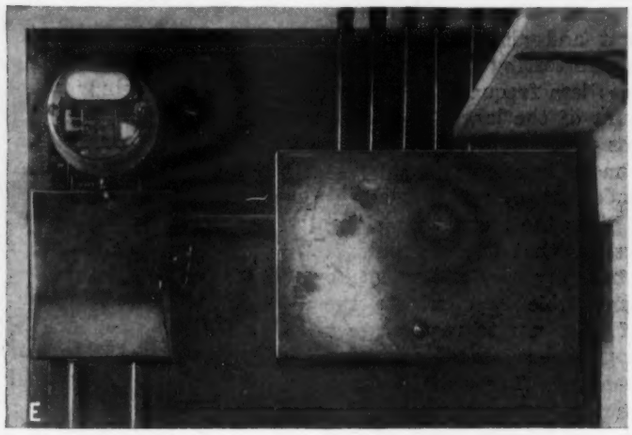
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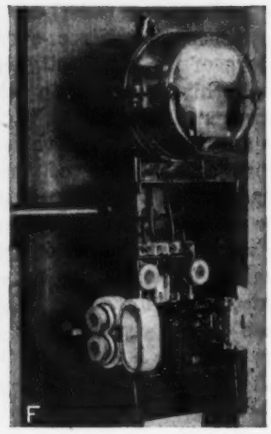
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Safety, prevention of theft of energy, compactness and low cost have been the objects strived for in the development of better types of customer meter installations. Protecting all wiring with conduit and the use of safety switches have eliminated dangers to persons and property. Covering the meter terminals with the switch box prevents "jumping" the meter and simplifies wiring. All of the installations shown above have these features, but simplicity and compactness are carried further in B and F, where the customers' fuses are mounted in knockouts in the safety switches, thus eliminating the separate boxes for fuses. Photograph A shows individual fuse boxes for each customer, while D and E show in one box the fuses for several circuits on one meter. At C is an installation with side-feed meters, of which the leads are protected from tampering. Here customers' fuses are not located at the meter.

be known. The use of demand meters in connection with the driving gears of the clock on the watt-hour meter involves direct gearing, and should this mechanism fail to operate it might affect the registration of the meter, entailing a loss of both demand and kilowatt-hours, a condition hardly possible with a separate contact device operating a record chart meter actuated by contacts in connection with the gear register. In this case, if the demand meter fails, which some do occasionally, the kilowatt-hour record is still correct. The writer believes that fully one-half of the difficulties experienced by the central stations, especially the smaller companies, are due to the fact that the men handling demand meters are not thoroughly familiar with their operation.

Demand meters are a much more complicated device than the watt-hour meters, and men handling these should have special training either at the factory or with some one who thoroughly understands their operation. It appears to be a mistake to endeavor to use three or four different types of demand meters, each with its own problems and different type of mechanism. This company is receiving very good results from demand meters because its men are trained to care for only one type. All measuring equipment is being standardized as far as possible, since more economical maintenance results and the tester becomes familiar with the device which he is endeavoring to maintain. It has been our practice for several years to send the foreman of the meter department to the factory yearly for instruction on demand-meter operation. This has resulted in improved operation of these devices reaching fully 50 per cent, and the manufacturers are eager to assist these men in order that satisfactory operation may be obtained.

An instance might be cited that happened several months ago in one district. Fully 80 per cent of the clocks were not operating properly. An inspection was made as to the probable cause, but it was not determined until an expert clock maker was sent to us from the factory. It had been the practice to allow local jewelers to clean and repair these clocks, and in doing so they had made adjustments that prevented the proper operation of the demand meter. The demand-meter clock is not to be compared with the ordinary timepiece and should not be repaired or cleaned at any other place than the factory.

Functions of the Standardizing Laboratory

An electrical laboratory has been established at Jackson, Mich., and provided with necessary standardizing apparatus, such as a potentiometer and standard cells, as well as with precision meters for the purpose of checking periodically rotating standards and with indicating instruments for the entire system. The laboratory maintains all meters and instruments, and in addition tests and adjusts relays as advised by the operating department. The supply is furnished by the use of a special three-unit testing set consisting of a 15-hp. direct-current motor driving two small generators, one furnishing three-wire, three-phase potential at 110 volts and 220 volts and the other being a 20-volt current generator for 150 amps., three-wire, three-phase. The speed of these machines can be varied from 20 to 64 cycles with a range of from 2 kw. to 5 kw. per machine. These machines were specially designed to produce true sine waves, and taps are brought out on the voltage machine for the testing of steel. The current generator is provided with a rotating armature that permits us to obtain any power factor between the potential and current generator from 20 per cent leading to 20 per cent lagging without any distortion of wave form. The electrical laboratory is held directly responsible for the accuracy of rotating standards and portable instruments, and the various meter departments are not permitted to break seals or readjust calibration.

Once a year a representative of the laboratory makes a complete inspection of the meter installations of the various primary customers, checking connections, current and potential transformer data, meter register, ratio dial constant, teeth on cam and operating demand meter, inspecting charts as to proper billing demand, and attending to other details in connection with the installation, in order that the highest accuracy possible may be obtained. This rigid inspection has more than paid for the expense. In addition to the electrical inspection a careful survey is made regarding safety, particularly that of the tester who makes the necessary calibration of the meters.

Making Meter Installations Safe

It is the writer's belief that the average utility has not taken a sufficient interest in the proper installation of meters. Many companies are confronted with outside conditions that result in the loss of energy or greatly increased cost of maintenance and tests. These conditions are squarely up to the central station, and would never have existed if rules and requirements had been published by the company specifying the proper location of the electric meter and insisting upon certain specifications that would provide satisfactory wiring. A survey of the average outside installation, especially on consumers' premises, shows that meter locations and wiring are far from ideal.

The three most important items in connection with customers' installations are: Conduit entrance, steel service cabinets and the proper grounding of secondaries. The enforcement of these requirements will result in a great deal of improvement to installations and wiring conditions and will be of great benefit to the consumer and the utilities. The writer would urge that the central station co-operate with the city and insurance authorities in requiring that the wiring on customers' premises be as safe as possible.

An open service exposes the utility to a loss of income from theft of electricity. The use of solder, iron, wire and miscellaneous material in the main-line cutout has resulted in the loss of thousands of dollars to the consumer from fire. While central stations should not exercise any authority over customers' interior wiring, they should specify the proper location of meters, and the service supplying these meters should be placed in metal and the main-line switch be suitably protected. The city or municipal authorities should require a thorough inspection as to the condition of the interior wiring, and the power company in no case should furnish energy to consumers unless a certificate of inspection can be produced showing that the wiring is safe and will not expose the customer to unforeseen life or fire hazards.

The use of open switches on main-line cutouts, or in any place where they are exposed to persons not having the proper respect for electricity, is a relic of the dark ages and represents a life and fire hazard. Their use in such places should be immediately discontinued and inclosed types required for all new installations. An inclosed switch, however, unless means are provided for

sealing, is of very little value to the company or consumer, and in order to obtain a completely steel inclosed installation the company should require that standard service boxes be installed. There has been considerable discussion as to why the central station should standardize on one make of service cabinet at one time. This is absolutely necessary providing an installation is required inclosing all wires and live parts, owing to a lack of interchangeability of meter trims or adapters.

The parties most vitally interested in the adoption of a proper service cabinet are the company and the consumer, the contractor only indirectly in its installation, and his responsibility ceases when the work is completed. The company is required to maintain a satisfactory service through this cabinet and should be supplied with means to permit a safe method of testing. The sealing of these cabinets is of considerable benefit to the consumer, as it prevents the use of material other than the proper fuses and is of benefit to the municipal authorities, as a switch can be locked, opened and sealed when the inspector considers the wiring unsafe. The use of service boxes should not be limited to single-phase residence use, but a cabinet should be adopted that can be installed on three-phase service simply by changing the interior, parts of the cabinet being limited by the actual dimensions of the box.

It is the author's opinion that the proper method should be for the company to adopt a standard box or a box on the market that would meet most of its requirements, and in co-operation with the municipal authorities and contractors' association arrange to have these installed by the contractors. This has many advantages over the other methods and provides a complete steel inclosed installation, standardization of meter installations and gives 100 per cent protection to the consumer and the utility.

Testing Instrument Transformers and Shunts

As in the case of most central stations, the revenue of the Consumers' Power Company is registered through transforming devices such as instrument transformers and shunts, in connection with direct-current meters of large capacity. The accuracy of this equipment is very important and provision should be made for periodically testing it in addition to the tests of meters or measuring devices. It is the intention to check the resistance of these shunts approximately every five years at the Jackson laboratory by the use of the Kelvin double bridge furnished by the Leeds & Northrup Company. This instrument is extremely reliable, its accuracy being guaranteed within one-fiftieth of 1 per cent. It utilizes the potentiometer method and can be used with comparative ease and simplicity. The question of checking the ratio and phase angle of current and potential transformers is rather complex and requires extreme care to obtain proper results.

The testing of those in service is exceedingly inconvenient and difficulties might be experienced in obtaining several points of the curve. It is the intention to remove current and potential transformers from the installation and test these in the meter department. The Bureau of Standards some time ago submitted what is known as the two-watt-meter method, the chief limitation of which is that it is slow. An instrument can be obtained which will read directly in ratio and phase angle and which will indicate the difference between the transformer under test and the standard transformer. A set of Siemens-Halske current and potential transformers has been purchased, the current ranging from 10 amp. to 1,200 amp., and the potential from 1,000 to 6,000. These transformers will be certified by the Bureau of Standards as to accuracy, after which they will be considered as standard transformers and service transformers will be checked against them. The results obtained by this method are extremely accurate, and it is possible to make a complete check on a current transformer both as to ratio and as to phase angle within a period of thirty minutes.

Selecting Oil Circuit Breakers

Advantage Should Be Taken of Fact that Voltage as Well as Current Drops When Reactance Is in Circuit and Breaker Opens at Voltage Below Normal

By H. L. Wallau
Electrical Engineer Cleveland Electric Illuminating Company

THE proper selection of oil circuit breakers for electrical systems is a matter the importance of which is coming to be very clearly recognized. Not only must a breaker be capable of handling the short-circuit currents of the present but allowances for reasonable growth must be made. Present-day prices make it imperative to select the least costly breaker suitable for the conditions to be met. Calculations, as generally made, have in certain cases the tendency to suggest the use of a breaker larger than is really necessary. The error is on the safe side from the point of view of operation, but may be on the wrong side financially.

For example, in the method commonly used when the station and circuit reactance and the generator capacity and voltage are known, the current is computed for short circuit at any given point and allowance is made for the decrement in short-circuit current due to the time setting of the breaker and relays. Then a breaker is selected having this current-interrupting capacity at

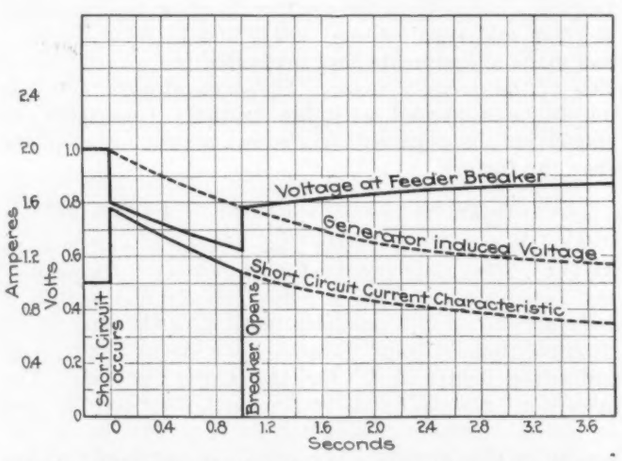

FIG. 1 — DROP IN VOLTAGE AND CURRENT AT FEEDER CIRCUIT BREAKER IN GENERATING STATION DURING A SHORT CIRCUIT

This action is based on the assumption that the generator speed becomes less during short circuit.

normal circuit voltage. It is a fact, however, that the voltage drops below normal on short circuit; consequently a smaller breaker might be used if the time settings are sufficient. Fig. 1 is a reproduction of one of the sets of curves shown by Dr. C. P. Steinmetz in his recent paper on the "Stability of High-Voltage Systems," before the American Institute of Electrical Engi-

neers. This illustrates the case of a feeder fed from a 60,000-kw., 9,000-volt turbo station with a reactor of 0.7 ohm per phase between feeders and station bus. This amounts to a 52 per cent reactance (will give a drop equal to 52 per cent of rated voltage if total generator current is flowing). The feeder was short-circuited for one second just outside this reactance. It will be noted that the short-circuit current to be interrupted at the end of one second (for the constants

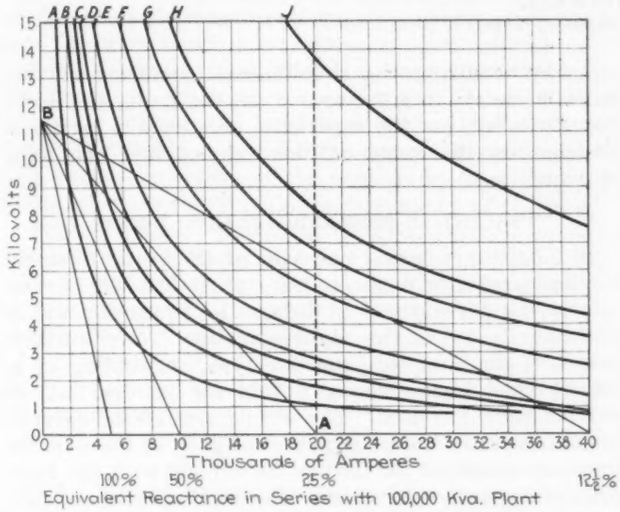

FIG. 2—RUPTURING ABILITY OF CIRCUIT BREAKERS UNDER VARIOUS VOLTAGES

assumed) is but slightly over the rated full-load current of the capacity connected to the bus, and that the voltage at the time of interruption is but 63 per cent of normal.

Now consider that such a line has a second breaker at its load end, and that this is set to open after 0.8 second, and assume a short circuit of zero impedance on the load side of this breaker. The short-circuit current, neglecting line impedance, would be somewhat greater for an interruption after 0.8 second than in the previous case with a one-second setting, but the terminal voltage at the point of short circuit would be zero, or practically so. The duty of the breaker is thus greatly reduced.

In order to select breakers for this class of service it has been found convenient to plot curves of rated interrupting capacity for various sizes of breakers at different voltages, as listed by the manufacturers (see Fig. 2). A series of straight lines may then be drawn on the chart as follows: For a given percentage of reactance the maximum short-circuit current at the system voltage is computed. For instance, take a 25 per cent reactance with a 100,000-kva. plant. This 25 per cent reactance is the sum of the equivalent reactance of the station units, external reactance and internal transformer reactance of the substation. With this reactance and a system voltage of 11,500 the short-circuit current would be 20,000 amp. This point is plotted at *A* in Fig. 2. This corresponds to zero terminal voltage at the substation. For zero current the terminal voltage is, of course, 100 per cent (*B* in Fig. 2). Therefore, by connecting the zero-current, 100-per-cent-voltage point (*B*), to the zero-voltage, 100-per-cent-short-circuit-current point (*A*)—for the equivalent reactance determined—a line is established showing the drop in voltage for increase in short-circuit current at the substation.

Any breaker whose characteristic rupturing capacity curve lies beyond this line will be capable of handling the short-circuit current at the substation. If allowance for increase in short-circuit current due to plant growth has been made in computing the maximum short-circuit current to the substation, the curve nearest the drop characteristics may be used. If not, some further leeway must be allowed and a larger unit selected. Thus, if it be determined that with a 100,000-kva. plant on an 11,500-volt system the reactance to a given substation will never be less than 25 per cent, the maximum short-circuit current would be 20,000 amp.

From this line it can be seen that breakers having the characteristic curves marked *A*, *B*, *C* and *D* are too small, but that the breaker whose characteristic is *E* will suffice. It is not necessary to use the breaker whose characteristic is *J*, as might be thought from the common method of calculating mentioned before. This switch is capable of interrupting the short-circuit current at a voltage in excess of system voltage.

If the substation is fed by a number of parallel feeders, the equivalent reactance for all of the circuits in parallel is, of course, the value that must be used in the numerical computations. Although the current to be interrupted by one breaker in a station fed by N lines in parallel is I/N of the total current, in the case of a fault just ahead of the breaker, where one breaker must open on reversal, the short-circuit current to be handled is $(N - 1)/N$ times the total current. In the case of a second circuit fed from the substation bus it may reach the total short-circuit value, if no additional reactance is interposed.

This also brings out the fact that in the case of substations fed by a number of lines in parallel the duty on the substation breakers may be substantially higher than that on the breakers on the sending end of these lines.

Maintenance of Chain-Grate Stokers

BY JOHN M. MAY
Traveling Engineer Iowa Railway & Light Company

ALLOWING clinkers to accumulate on the side walls of the furnace is about the most common cause of stoker troubles. This causes more grates to stick than almost any other one thing, and it is too often the case that a stoker is allowed to run in this condition until the drive will no longer pull it. When this happens the obvious course should be to find out the cause of the trouble and remedy it, and not to try to force the grate with a bar until the grate or some part of the drive gives way.

Lack of proper maintenance also manifests itself in the stoker drive or gears. If the bearings are allowed to become worn and loose, the gears fail to mesh and begin to climb. This may do damage to several parts of the stoker. Perhaps the gear teeth or the bracket will break, and sometimes the front frame of the stoker is cracked.

The chain grate should be kept taut, and attention should be given to the rollers so that the stoker is always in line and square. There is no excuse for allowing the ashes to build up as high as the grate. When this is done the grate, and often the back roller shaft, are burned. This entails expensive repairs. Consequently, if it is noted that the ashes are touching the grate, the stoker should be immediately shut down before any actual damage is done and the ashes should be removed before the stoker is started again.

Tendencies in Relay Protection

Centralized Supervision of Protective Equipment Increasing—Keener Analyses Being Made of Character of Faults and Limitations of Protective Equipment, More Accurate Applications Resulting—Differential Relay Practice in England Is New Development

By R. N. CONWELL
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SEVERAL of the larger power companies have placed the protective equipment of their respective systems under the centralized control of one department, generally engineering, contact being maintained with the other departments in order that their ideas and experiences may be correlated with the engineering features. The work of these engineers is being summarized by one of the committees of the American Institute of Electrical Engineers so that there may be available an analysis of the results obtained through the use of different protective schemes under a range of conditions not obtainable on any one system. As a result of this action keener analyses are being made of the character of faults and the limitations of protective equipment. More accurate applications are also resulting from these analyses.

There is a wide divergency between the conditions existing on the various transmission systems, the protection of which requires the adoption of different schemes and sometimes new developments in both schemes and relays. Some of the recent developments worthy of notice have been in the field of differential current protection, pilot wire protection, ground protection and service restoring devices. The manufacturers are meeting these demands as rapidly as the new conditions are defined and established.

The problem of protection even under the most favorable circumstances is complex; consequently more consideration is being given to the design of transmission and distribution systems which may be protected by simple, reliable relay installations with a minimum of auxiliary equipment.

OVER-CURRENT AND DIRECTIONAL PROTECTION

In general, schemes employing over-current and directional relays are still utilized as the principal form of line protection, even in the most complicated networks, but their application on large systems is limited by the danger incurred in holding short circuits for more than two seconds. This condition has forced the adoption of differential protection to eliminate or reduce time settings, and more attention is being given to schemes of this character than heretofore.

Where lines are operated in parallel, differential protection based upon the condition that the faulty line carries the greatest current has been used in a number of instances. Some difficulty has been experienced with these schemes, when applied to systems having high short-circuit values due to surges accompanying the re-establishment of normal conditions after the release of the faulty line, operating the relays and tripping out good lines. Experimental work with time-delay, circuit-opening relays connected to open the trip circuits of paralleling line breakers for a predetermined interval gives promise of overcoming this difficulty. Other schemes of electrically interlocking the trip circuits by requiring the simultaneous operation of two banks of relays in order to trip out the faulty line have been installed, but the experience necessary to render a decision on the value of this scheme has not been obtained.

PRACTICE IN ENGLAND HAS GOOD POINTS

In England, where a majority of the power systems employ parallel or duplicate lines, there has been a very interesting development in differential protection which undoubtedly is in the right direction. Over-current relays of the so-called "reactive type," consisting of a set of fixed coils forming a field for another set of moving coils, are used. The secondaries of the current transformers in the same phases of each of the parallel lines are connected for circulating current with the fixed coils of the relays in series. The moving coils are connected to the equipotential points in the secondary network; therefore under normal balanced conditions no current passes through these coils.

However, the occurrence of a fault on one line causes a differential current to flow through the moving coils, which are so connected, considering polarity, that the relay with trip circuit to the breaker on this line will close its contacts, while the relay connected to the trip of the breaker on the parallel line will be restrained or held open by the differential current. If the fault had appeared on the latter line, the direction of the differential current would have been reversed, causing a reversal in the operation of the relays. The entire output of the current transformers being used for the excitation of the fields of the relays makes them capable of very sensitive settings—more sensitive, in fact, than can be utilized in practice, since the setting is dependent upon the degree of unbalance between lines. If the lines are balanced to within 1 per cent at normal load and subjected to twenty times normal load on through short circuits, it is evident that a 20 per cent normal-load setting is insufficient to insure stability.

This scheme, when compared with those of the same class in use in this country, presents a number of distinct advantages. These are simplicity, high sensitivity as required, elimination of potential transformers, the fact that only faulty line relays may operate, all others being restrained, and the further fact that the scheme may be applied to two or more parallel lines by simply adding equipment as new lines are installed, no changes in existing equipment being required.

Applications of the same principle have also been made for the protection of transformers, generators, twin lines, and single lines with pilot wires.

PILOT WIRE PROTECTION

In several instances the practice of looping a line through a large number of customers' substations has forced the abandonment of over-current and directional

relays, on account of the time elements involved, and the adoption of pilot wire schemes. Generally these substations are installed at short distances from one another so that the installation of short pilot wires means a relatively small initial investment. One of the largest power companies now has installations of this kind and of its own design in satisfactory operation.

Another pilot-wire scheme which has been developed for this type of service consists of three pilot wires and a neutral wire connecting for circulating current the secondaries of current transformers at one end of the line to the corresponding transformer secondaries at the other end. Over-current relays at each end are connected between the pilot wires and the neutral wire. In order to prevent the leakage of part of the current through the relays under normal operating conditions, owing to the resistance of the pilot wires, special current transformers having a secondary rating of 0.5 amp. or 1 amp. are used. This gives a correspondingly small potential drop between the two ends of the pilot and at the same time requires the use of a high-impedance relay operating on small current. When a short circuit or ground occurs on the line, the secondary currents no longer circulate, but are opposed, so that current must flow through the relays and trip the breakers at each end of the line.

Ground Protection

The practice of grounding the neutral of power systems has given impetus to the adoption of ground or residual relay protection. Experience in this country and abroad has shown that in both cable and open-wire systems the majority of faults develop first to ground. The practice of using only phase-to-phase protection results in considerable delay in clearing a faulty line, as the phase relays do not begin to function until after the ground fault has developed into a phase-to-phase fault of considerable magnitude. The release of a line under these conditions frequently causes severe disturbances. On high-voltage systems the fault to ground may never develop into a phase-to-phase fault on account of the wide spacing of conductors. High-resistance grounds limiting the current to relatively small values which will not operate phase relays may occur on any system.

A selective ground-relay scheme to protect transmission systems against the classes of faults referred to has been developed and put into operation on several systems. On outgoing lines a low-impedance over-current relay with low pick-up value is connected in the ground lead between the neutral point established on the ground side of the phase relays and ground. Unbalanced current resulting from a ground on one phase of the line will cause current to flow through this relay, tripping the breaker. On incoming lines a similar installation is made, but in this case the directional elements used in conjunction with the phase relays are used with the ground relay by connecting the trip circuit of the ground relay in parallel with the trip circuit of the over-current phase elements. Discrimination is obtained by use of time and unidirectional elements.

Many of the interruptions occurring on overhead lines are the result of lightning and similar causes. Although these disturbances are transient in character, they frequently cause short circuits and flash-overs which trip line breakers. The undamaged line may be immediately returned to service. A system of relays has been developed to reclose the breaker automatically as soon as it has been opened by the line relays, the speed of the device being such that service has been restored in less than one second after the breaker opened. Should the line be permanently short-circuited, the breaker will continue to open and close any desired number of times in accordance with the setting on a limiting relay.

The use of differential protection for generators and power transformers is being rapidly adopted throughout the country. The only troubles experienced with this form of protection have been due to improper phasing or the use of settings which are lower than justified by the degree of balance obtained.

Modern Practice in Westport Station Design

Safe Operation of Generator Fire-Fighting Apparatus, Prevention of Ceiling Condensation and Welding of Steam Piping Are Important Features

By M. D. Engle
Consolidated Gas, Electric Light & Power Company

A UNIQUE method of handling coal received by water at the Westport (Baltimore) station was fully discussed in the Electrical World, Jan. 15. It was also shown how the plant must supplement the Holtwood hydro-electric station to make maximum use of the water available at Holtwood. In this article a number of features typifying modern thought in steam generating station design, as carried out in the Westport station, are discussed.

Great care has been taken in the layout and installation of all piping so that the whole structure is highly flexible. Nearly all piping over 2½ in. (6.4 cm.), with the exception of galvanized piping, is butt-welded except at valves. Reinforced Van Stone flanges are used at the valves. The use of field welds has proved highly satisfactory and has reduced gasket trouble to a minimum. This installation has definitely demonstrated the practicability and economy of field welds made by the oxyacetylene method. All boiler-feed, condensate and salt-water piping and flanges are galvanized. Pipe bends have been substituted for fittings wherever possible in all steam and hot water lines. As seen in Fig. 1, page 134, Jan. 15 issue, each battery of six boilers supplies steam through a common header to the supply header running parallel to the turbine room.

All piping carrying steam or hot water has been insulated with 85 per cent magnesia covering sewed over with heavy 8-oz. (0.23-kg.) canvas. The canvas is sized and painted different colors to denote the service of the pipe and to facilitate the tracing of lines. High-pressure steam and boiler-feed lines have insulation 3 in. (7.6 cm.) thick and exhaust steam 1½ in. (3.8 cm.) thick. Boiler drums, front and rear, feed-water heaters and receivers are covered with magnesia plastic cement 3 in. thick, reinforced with wire mesh and finished with hard coating. Valves, fittings and flanges are blocked in and given a hard-coat finish.

All 20,000-kw. units are surface condensing, being equipped with 32,000-sq.ft. (3,000-sq.m.) Westinghouse Le Blanc condensers and auxiliaries. They operate at a vacuum varying from 28 in. to 29.6 in. (711 mm. to 742 mm.) Hg. referred to a barometric pressure of 30 in. (762 mm.) Two 25,000-gal.-per-min. (95,000-l.-per-min.) circulating pumps, two Le Blanc air pumps and two condensate pumps are installed in connection with

each surface condenser. Both circulators are driven by means of turbines through reduction gears, and one circulator has in addition to the turbine drive an induction motor attached to the other end of its shaft. One air pump and one condensate pump are mounted on the same shaft, and one such unit is driven by a turbine through a reduction gear and one by an induction motor. With this arrangement fine heat-balance adjustments may be obtained and waste of exhaust steam prevented.

A portion of the condensate from the hot wells is bypassed into small jet condensers which are used to condense the steam which leaks through the labyrinth packing at the high pressure end of the Curtis turbines of the General Electric units. The water from these condensers is discharged into a sump tank in the turbine-room basement and pumped to the feed-water heater surge tanks.

The condensate piping is so arranged that the condensate from any machine may be pumped to weighing tanks on the boiler-room floor. After being weighed the water is discharged into a sump tank in the boiler-house basement and from here is pumped to one of the feed-water-heater surge tanks. This arrangement makes it a comparatively simple matter to run a water-rate test on any unit equipped with a surface condenser.

At the present time the condenser circulating water is taken in through two concrete-pipe intake tunnels and screened by means of two 10-ft. (3-m.) revolving screens as it enters the rectangular intake tunnel under the boiler house. Construction work is now in progress on a new screen well at the water front which is to contain six 10-ft. (3-m.) revolving screens.

All electric ends of the turbo-generator units are cooled with washed air and arrangements made to discharge the heated air into the turbine room or into the blower rooms of boiler house No. 3. The former arrangement is necessary in order that sufficient warm air may be discharged into the turbine room in the winter to prevent excessive condensation on the turbine-room ceiling. By delivering the extra heated air to the blower rooms a considerable heat saving is effected. The air washers take their air either from the turbine room near the ceiling or from outside windows.

Generator Fire Protection

The electric ends of the turbo-generator units are equipped with permanent fire piping. A number of nozzles extend through the end bells from an exterior header and are so directed that they can thoroughly drench the end windings of the generator. To prevent water being turned on by accident, the fire piping header is normally disconnected from the service-water system. In case of fire service may be quickly established by means of a short piece of fire hose and a quick-acting valve inserted at the base of the generator.

Two motor-driven exciters in the old engine room furnish the excitation for the engine-driven units and the first three turbo-generator units installed. The last four units have direct-connected exciters and are so arranged that they may operate from their own exciter or from the exciter bus supplied by the motor-driven exciters. A 300-kw. turbine-driven exciter is now being installed and will be connected to the exciter bus. The turbine-driven, motor-driven or direct-connected exciters will then be used, depending upon the heat balance of the station. In the winter, when there is a scarcity of exhaust steam for the feed-water heaters, the turbine-driven exciter will be run continually, and only such motor-driven exciters as are needed to carry the rest of the excitation load. In summer the conditions will be reversed. There will be a surplus of exhaust steam, and the motor-driven and direct-connected exciters will be loaded. A storage battery floats on the exciter bus.

Provision for Opening Generator Field

All units are switched to either of two duplicate 13,000-volt buses. The turbine-driven General Electric Company machines have 3 per cent reactance coils connected in their neutrals to give them a total reactance of 10 per cent. The Westinghouse machines contain sufficient inherent reactance to make additional reactors unnecessary. All of the generators are operated with their neutrals solidly grounded and are provided with balanced relay protection, so that the generator oil switches will open up owing to any failure in the generator windings or in the leads between generator and oil switch. These switches, however, will not open up on overload. In case a severe short circuit or ground occurs on the system, one which will cause more than 250 per cent of the normal rated armature current to flow, the generator field will be automatically opened. The field will automatically be closed again when the armature current drops to its normal rated value. This gives the feeder oil switches sufficient time to open and clear the system of trouble. The operation of this field-destroying device minimizes the severity of the short circuit and better enables the feeder oil switches to clear the system of trouble.

Service is taken direct from either of the station buses for the 13,000-volt feeders, while the 26,000-volt station ties are connected through four 12,600-kva. three-phase auto-transformers installed in an outdoor substation. On page 136, Jan. 15 issue, is shown the outdoor substation and the transformer repair frame used for disassembling and assembling the transformers. These transformers are operated with their neutrals grounded, and their hot-spot temperature is indicated by an instrument in the operating room. Customers in the vicinity of the plant are supplied with 4,000-volt service from two banks of 13,000/4,000-volt transformers.

Service for the station auxiliaries is taken from the main buses through four banks of 13,000/460-volt transformers. The load is so distributed to these four banks that the loss of two banks will not prevent operation.

A rather interesting system of load dispatching is used by the operators in the Holtwood hydro-electric station and the operators in the Westport plant during times of high flow. At such times it is obviously the best policy to generate the fewest possible number of kilowatt-hours at Westport. It is important, if this policy is to be carried out, that the Westport station should not pick up any load until the Holtwood station is fully loaded, and that Westport should "back off" enough to keep Holtwood fully loaded when the system load begins to fall off. To accomplish this, the operators at Holtwood set their governors for 25¼ cycles and the operators at Westport set their governors for 25 cycles. Under this condition the system frequency will be 25¼ cycles until Holtwood is fully loaded. When this condition is reached the frequency gradually falls to 25 cycles and Westport picks up the rest of the load and maintains the frequency at 25 cycles. When the system load begins to fall off the Holtwood machines, with their governors still at 25¼ cycles, pick up speed and maintain full load, while Westport, seeing the frequency begin to rise, "backs off"—a method automatic and quite satisfactory.

Auxiliary Transformer Reduces Inductive Interference

Transformers with Grounded Delta-Connected Secondary at Receiving End of 60,000-Volt Line Reduces Noise on Parallel Telephone Line

By L. J. Moore
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By connecting an auxiliary transformer bank with grounded delta-connected secondary and operating without a ground wire on the primary of the transmission line, it was found in a recent test by the San Joaquin Light & Power Corporation that noises on a parallel telephone circuit were practically eliminated. These tests were made on the 60,000-volt line from Santa Maria, Cal., to Divide, which parallels a toll line of the Santa Barbara Telephone Company for a distance of about 3 miles (4.8 km.), the two lines being at approximately highway separation. The 60,000-volt line is of equilateral triangle construction, each side of the triangle being about 7 ft. (2 m.). Two power-line transpositions are installed within the limits of the parallel. During the test the telephone company opened its lines at each end of the parallel and readings were taken only on the parallel section. The power transformers at Divide are three 1,250-kva. Allis-Chalmers units star star-connected for 36,000 volts to 6,683 volts. The auxiliary bank used for absorbing the triple harmonics consists of three 299-kva. Allis-Chalmers transformers of the same voltage rating. The connections of these lines and the location of instruments are shown in the accompanying drawing, and the attached table shows the tests and the readings made.

This transmission line is about 10 miles (16 km.) long, and 5 miles (8 km.) from either end is connected a 60,000-volt grounded Y to a 2,300-volt delta bank of transformers at Betteravia. During tests 1 to 6 the Betteravia bank was connected on the line, and in tests 7 and 8 this bank was disconnected.

The tests were made as follows:

Test No. 1—60,000-volt line alive; no transformers connected.

Test No. 2—The line was alive and the power bank at Divide was connected unloaded.

Test No. 3—The same as No. 2, except that the power bank was carrying 1,080-kw. load.

Test No. 4—The power bank and the auxiliary bank were connected and the delta of the auxiliary bank was left open.

Test No. 5—The same as No. 4, except that the delta of the auxiliary bank was closed.

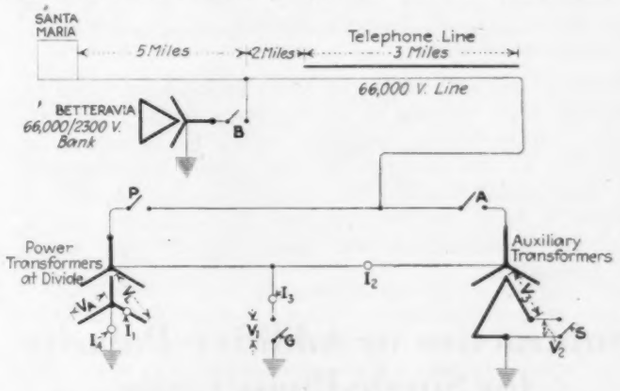
Test No. 6—The same as No. 5, except that the ground was removed from the high-tension neutral.

Test No. 7—The power transformers were carrying load, the high-tension neutral was grounded, and the auxiliary bank was connected with the delta closed. The Betteravia bank of transformers was disconnected in this test. This test was the same as No. 5 with this exception.

Test No. 8—The same as test No. 7, except that the delta of auxiliary bank was open. This removed the short-circuiting path for triple residual currents and changed the inductive effect to an almost entirely electrostatic one. In this test a large triple voltage was obtained.

The interference on the telephone line in the table is given in noise units, twenty noise units being so low as to be scarcely audible, while 200 units on such a short section make the telephone line too nosiy for good operation.

An additional test made with the 60,000-volt line dead and grounded showed practically no difference in noise from that in test No. 1, when the line only was alive. The table shows that with the auxiliary bank connected and with high-tension neutral grounded (test No. 5) some reduction in interference results; but the real correction comes by isolating the high-tension neutral after the auxiliary bank has been connected (No. 6). With such an arrangement there is practically no interference whatever. This is apparently not a dangerous procedure, as test No. 6 shows a maximum of 520 volts between the neutral and ground when the ground is disconnected. By comparing tests No. 2 and No. 3 it is seen that a load on the power transformers has no effect on interference. It is evident from readings V_1V_a of tests Nos. 7 and 8 that triple voltages have no effect on the voltage between the wires of the 10,000-volt circuits, but with the triple voltages (test No. 8) the voltage between wires and ground increases about 10 per cent. This means that power transformers with delta-connected secondaries would not be affected, but that 6,600-volt star-connected banks would be. However, even if there were no 6,600-volt star banks present the wave form would be badly distorted were not some



ONE-LINE DIAGRAM OF CONNECTIONS FOR INDUCTIVE INTERFERENCE TEST

Letters I_1, I_2, etc., represent ammeter readings and V_1, V_2, etc., represent voltmeter readings.

means provided for the removal of triple voltages and current. Test No. 8 shows approximately 16,000 volts triple emf. added to each phase on the high-tension side where the auxiliary bank is not connected. This means 48,000 volts total for the line between the three transmission wires and ground, which, as may be noted, causes a great amount of noise on the telephone circuit.

With connections as in test No. 6 it was found that the power from triple harmonics carried by the auxiliary bank correcting the three power transformers only was 50 kva. per transformer. When the Betteravia bank was off the line (test No. 7) the power per phase was 126 kva. Thus in neither event are the auxiliary transformers overloaded. The 50 kva. is but 4 per cent of the total capacity of one 1,250-kva. transformer. With the neutral isolated, which is the best condition from an interference viewpoint, a smaller transformer than 200 kva. would operate satisfactorily except for the fact that any unbalance in load between phases of the substation would cause increased current to flow in the auxiliary banks; also an open circuit or a ground in

one phase of the 60,000-volt line would force short-circuit current through the delta of the auxiliary bank. Therefore this bank must be large enough to withstand abnormal conditions. The present 200-kva. bank is 16 per cent of the rating of the main power transformers, which is probably large enough for all conditions, but experience must prove this fact.

Properly designed tertiary windings on single-phase transformers, or three-phase core-type transformers, provide a better solution than the installation of an auxiliary bank. Moreover, although single-phase transformers with a tertiary winding will cost more than transformers without it, the whole installation would be cheaper than putting in an auxiliary bank. Furthermore, no switching facilities would be necessary in addition to the switches for the power transformers. A three-phase transformer offers a saving in cost, is easier to wire and requires less bus structure, but it has the disadvantage that spare transformers would be expensive.

CONDITIONS AFFECTING NOISE ON TELEPHONE CIRCUIT

Test No.	1	2	3	4	5	6	7	8
Switch B	*Cl	Cl	Cl	Cl	Cl	Cl	Cl	Cl
Switch D	Cl	Cl	Cl	Cl	Cl	Cl	Cl	Cl
Switch P	Open	Cl	Cl	Cl	Cl	Cl	Cl	Cl
Switch G	Open	Cl	Cl	Cl	Cl	Open	Cl	Cl
Switch A	Open	Open	Open	Cl	Cl	Cl	Cl	Cl
Switch S	Open	Open	Open	Open	Cl	Cl	Cl	Open
I_1	.....	2.5	.....	.....	.....	.....	.....	.....
I_2	.....	.....	.....	.....	3.9	3.1	.....	.....
I_3	.....	3.5	3.2	3.9	.....	.....	8.8	4.4
I_4	.....	0	0.88	0	0	0	.....	.....
I_5	.....	.....	.....	.....	8.8	7.7	20	.....
V_1	.....	.....	.....	.....	.....	.....	10,400	10,400
V_a	.....	7,140	.....	.....	6,900	7,080	6,000	6,600
V_1	.....	.....	.....	.....	.....	520	.....	.....
V_2	.....	.....	.....	1,270	.....	.....	.....	7,920
V_3	.....	.....	.....	6,570	6,480	6,480	5,880	6,400
Noise units:								
Grounded line	20	200	200	.....	150	20	325	400
Metallic line	30	30	30	.....	20—	20—	33	60

*Cl means switch is closed.

Subtractive or Additive Polarity for Single-Phase Units

Voltage Stresses on the Insulation Are Less for the Subtractive Polarity as Shown by a Series of Diagrams for Operating Conditions

BY C. W. PIPER
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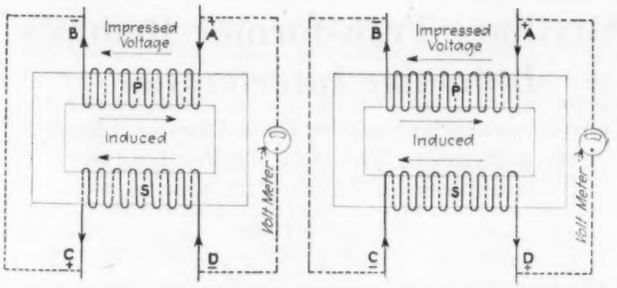
EFFORTS to standardize transformers as to polarity of windings as well as to ratings have brought forth considerable discussion as to the relative merits of the connection schemes giving subtractive and additive polarity. The N. E. L. A. committee on electrical apparatus is advocating more complete adoption of a standard subtractive polarity for transformers. A comparative study of insulation stresses in transformers for normal and abnormal operating conditions shows the advantage in this respect of the subtractive polarity scheme. The terms additive and subtractive polarity are best explained by reference to Figs. 1 and 2. The primary current will flow in at *A* and out at *B*, as the counter emf. is enough less than the impressed to permit the magnetizing and load current to flow. In the secondary the current tends to flow out at *C* and in at *D*, as it is produced by the induced emf., which is opposite in direction to the impressed. If the



FIGS. 1 AND 2—TRANSFORMER WINDINGS FOR (1) ADDITIVE AND (2) SUBTRACTIVE POLARITY

adjacent ends *C* and *B* of the primary and secondary winding are connected together, the voltage between *A* and *D* will be the sum of the coil voltage; thus the name additive or positive polarity.

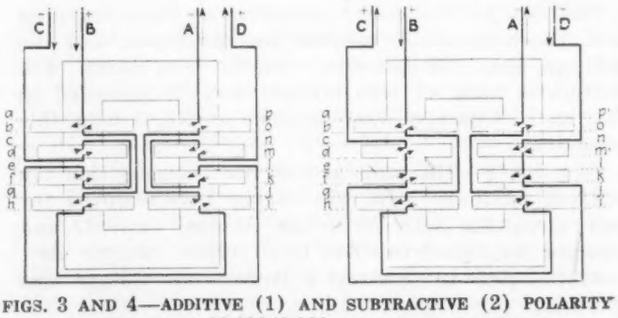
For a transformer of additive polarity the currents on both the primary and secondary sides flow into the transformer on adjacent leads. It will be noted in Fig. 1 that the primary current enters at *A*, while at the same instant the secondary current enters at *D*, which is the reverse of the current in the line.

If the secondary is wound in the opposite direction, the induced emf. will be reversed as in Fig. 2, and connecting *B* to *C*, the voltage across *A* and *D* will be the difference between primary and secondary volts, giving a subtractive or negative polarity. The effect of subtractive polarity as to the relative direction of flow of current in the primary and secondary leads is such that the current in the line might be thought of as flowing into the load as though the transformer were not present in the circuit. The primary current entering at *A* and the secondary current leaving the adjacent secondary side at *D* (Fig. 2).

The polarity of a transformer depends upon two conditions, one the winding polarity and the other the way the leads are brought through the case. There is generally little space or clearance to permit the crossing of leads inside the case as they have to be carefully insulated. The proper way is to bring the leads straight from the coils, and if the polarity has to be reversed make the change outside. There is generally ample room to do so.

A standard core-type transformer of four "high-low sections," with a primary voltage of 66,000 and secondary voltage of 22,000, is shown in Figs. 3 and 4. The direction of the current in the leads at a given instant is indicated by the arrows. It will be noted that the ends of the windings marked positive are above ground potential, while the negative ends are below ground potential.

The normal insulation stresses on the transformer with additive polarity are shown in Fig. 5a. The



FIGS. 3 AND 4—ADDITIVE (1) AND SUBTRACTIVE (2) POLARITY APPLIED TO 66,000/2,200-VOLT TRANSFORMER

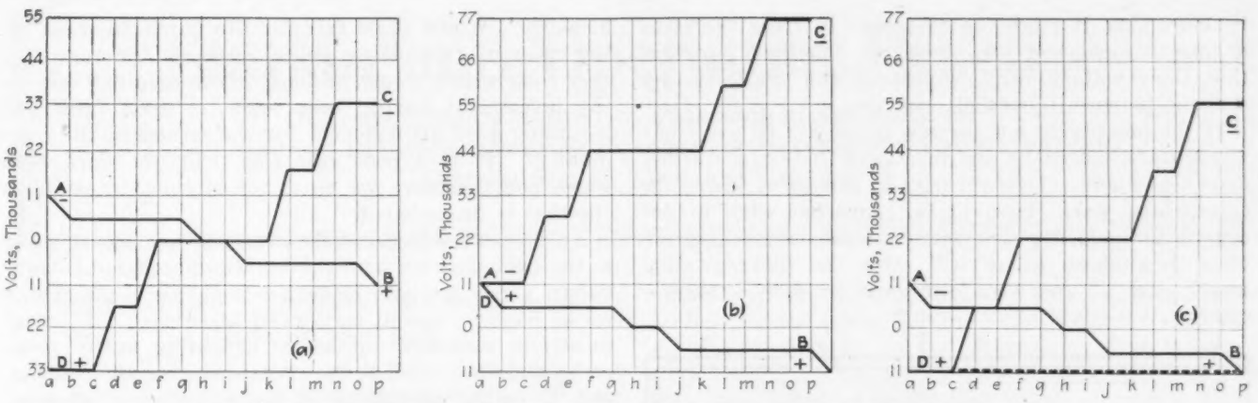


FIG. 5—VOLTAGE STRESSES ON INSULATION OF TRANSFORMER WITH ADDITIVE POLARITY
(a) Normal, (b) when leads *A* and *D* are crossed, (c) *D* and *B* are connected. The most severe strain on the insulation occurs when *A* and *D* are crossed, giving 88,000 volts between *C* and *B*.

induced voltage will cause the adjacent ends of the primary and secondary windings to have potentials of opposite signs at any instant. This gives an insulation stress of 44,000 volts, which is greater than if the two ends were both of the same sign on the same side of ground potential. If by any accident the adjacent terminals *B* and *C* or *A* and *D*, or conductors connected to them should come into contact with each other, the voltage stress between the primary and secondary windings will be as in Fig. 5b, wherein the voltage difference increases from zero at the point of contact to 88,000 volts, the sum of the primary and secondary at the free ends *B* and *C*. Should the primary terminal on one side come into contact with the opposite secondary terminal the potential at the point of contact would be the same and the stress between the windings would be shown in Fig. 5c, which gives a maximum stress of 66,000 volts at the free ends *C* and *B*.

With the transformer wound for subtractive polarity —that is, the primary reversed with respect to the secondary—the relative direction of the voltage and current in the windings will be reversed as shown by the arrows of Fig. 4. The normal insulation stress between windings due to the induced volts will be a maximum of 22,000 volts (Fig. 6a), which shows the insulation stress to be less throughout the entire group of coils than with the additive polarity. If either of the adjacent primary and secondary leads should get into contact with each other, such as *A* and *D* or *B* and *C*, the distribution of the potential is shown by Fig. 6b. Under such a condition the maximum stress between end coils would be 44,000 volts, which is the difference between the primary and secondary voltage. Should *A* and *C*, or conductors connected to them, get into contact with each other, the distribution of stress at any point in the winding is as in Fig. 5c, with a maximum of 88,000 volts, the sum of the primary and secondary, this being between the end primary on one leg and the end secondary on the other.

INSULATION STRESS IS LESS WITH SUBTRACTIVE POLARITY

A study of the voltage stresses between windings of the two polarities shows conditions in favor of subtractive or negative polarity. The maximum stress between primary and secondary under normal conditions with subtractive polarity is 22,000 volts, while with additive polarity it becomes 44,000 volts, and should adjacent ends or conductors connected to them get into contact with each other, the maximum stress between windings for subtractive polarity is 44,000 volts (for additive polarity 88,000 volts).

The choice of polarity for the small low-voltage distributing transformer is relatively unimportant, as with voltages as low as 2,200/110 volts it makes little difference, so far as insulation stresses are concerned, whether the transformer is of additive or subtractive polarity. Additive polarity was used by the earlier manufacturing companies, so it has come into considerable use in distributing systems. The subtractive polarity is safer and more reliable. The higher the voltage the more true this becomes.

The polarities of transformers that are to operate in parallel have to be the same; thus the polarity should

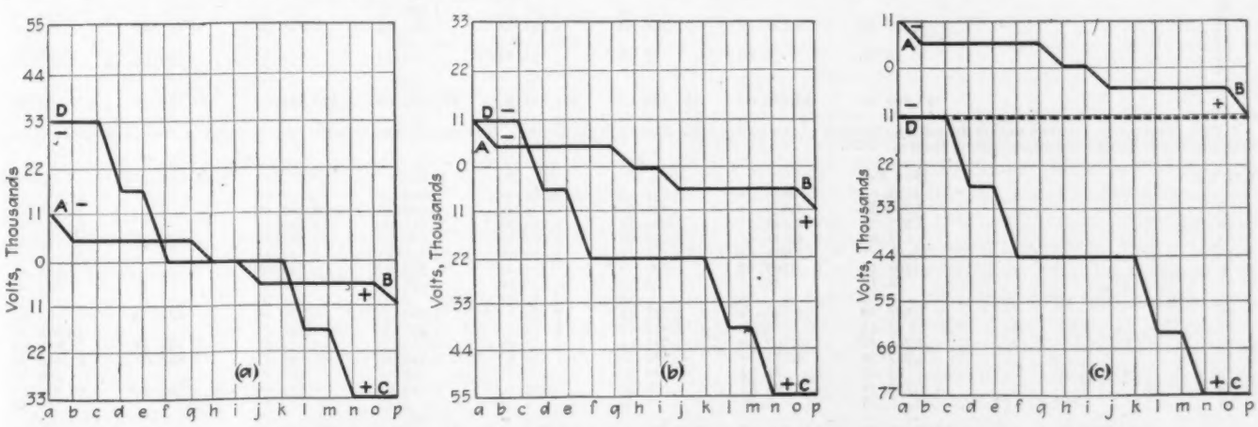


FIG. 6—INSULATION STRESSES ARE DECREASED BY SUBTRACTIVE POLARITY

be known, as it might be necessary to cross the leads of one before they are connected together, provided that their voltage ratio, resistance and reactance are such as to permit parallel operation.

If the polarity is not correct, there will be a serious disturbance caused by the reaction of one transformer upon the others. Transformers in groups of three, for three-phase work, have to be connected with proper regard for polarity, as a study of the vector diagram of a three-phase group will show the difficulty that would exist if one were connected in with a reverse polarity.

Readers' Views and Comments

Actual Versus Reproduction Cost in Public Utility Appraisals

To the Editor of the ELECTRICAL WORLD:

SIR: Concerning the editorial in the Aug. 21, 1920, issue of the ELECTRICAL WORLD on "Danger in Valuations at Present-Day Figures," referred to in a letter from Harold Almert in the issue of Dec. 4, 1920, I cannot take any other view than that of the ELECTRICAL WORLD, which advocates the actual or historical cost as the only sound basis of valuation of public utility properties for rates and return.

If a corporation has made an investment for the service of the public of, say, a million dollars, extraordinary conditions of a world war do not entitle the company to reap interest on an additional million, as would probably be the case if the property were valued at reproduction cost during these times. Suppose that extraordinary conditions of depression should follow and the million-dollar property could be reproduced for $500,000. Would it be fair for the public to insist on the rates of this utility being based on the reproduction cost, which would be half of the original value—the investment having been made in good faith and assuming good management for the service of the community? It is a poor rule that will not work both ways, and therefore we must not attempt to establish one that is inconsistent.

An investor who purchased the pre-war securities is in the same position with the one who purchased Liberty bonds. They are both below par, and this is the chance we all have to take in matters of investment. In order to attract sufficient capital for extending utility properties and developing hydro-electric energy, the commission is taking cognizance of the necessity of allowing a sufficient return under present-day conditions to attract the necessary capital for the needs of public utilities.

As to keeping track of our original installation, it is simply a matter of bookkeeping. It is true that certain property loses its identity. However, if the books are properly kept, the value of the original installation less depreciation, under regulation where a depreciation reserve is set up and where replacements are charged against it and the necessary maintenance is charged directly to the operating expense, is carried along as per schedule submitted herewith. When a property is valued by the engineers of the commission or any other engineers, it will not be difficult to ascertain the historical cost of the property and the value at the present time provided that the accounts are kept in the proper manner.

It does not seem to me that it would be sound reasoning to take reproduction cost at any time as the basis for rate making. The actual or historical cost is fundamentally the sound basis to take. Neither the customers of a corporation nor its owners have the right to reap where they have not sown, and this is what happens unless we take the historical cost as a basis for valuation.

C. WELLINGTON KOINER,
Pasadena, Cal. Consulting Engineer.

DEPRECIATION BY YEARS (From which present value is readily found)

Acct. No.	1906–07	1907–08	1908–09	1909–10	1910–11	1911–12	1912–13	1913–14
7	.....	$358.11	$462.11	$469.96	$455.96	$475.93	$584.81	$618.09
9	$657.72	2,008.74	1,962.83	2,616.42	2,671.03	2,960.33	3,295.98	3,518.04
10	681.61	1,930.43	1,877.15	2,838.23	3,233.12	3,884.53	4,658.43	4,704.26
14	.....	11.19	806.85	1,706.13	2,116.14	2,345.62	2,876.93	3,319.63
15	.....	7.51	539.95	1,167.24	1,482.20	1,684.27	1,997.16	2,389.19
16	.....	.....	.....	.....	.....	.....	78.56	139.90
17	.....	.....	.....	.....	.....	.....	13.38	26.77
18	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	34.56	280.81	646.51	773.58	900.70	1,210.41	1,564.76
21	.....	.....	.....	.....	.....	.....	.....	.....
22	.....	.....	537.88	1,143.23	1,900.97	2,051.92	2,389.15	2,824.70
23	3,117.29	5,121.10	5,223.39	5,163.52	5,094.18	4,891.04	6,451.47	6,720.06
27	.....	.....	.....	.....	.....	.....	.....	37.15
28	10.00	19.00	37.10	65.81	175.51	334.32	973.05	1,545.70
29	.....	.....	.....	.....	.....	.....	.....	.....
	*$4,466.62	$9,490.64	$11,728.07	$15,817.05	$17,902.69	$19,528.66	$24,529.33	$27,408.25

* This depreciation covers a period during construction of the plant, 1906–07, and is premature. However, it goes to offset the changing of 60-cycle generators to 50-cycle, which change was made during the year 1910.

Acct. No.	1914–15	1915–16	1916–17	1917–18	1918–19	1919–20	Replacements	Total
7	$654.85	$686.04	$752.92	$810.34	$816.36	$867.06	.....	$8,012.54
9	3,794.72	4,829.15	4,227.30	4,596.86	4,628.65	4,662.54	.....	46,430.31
10	5,375.57	8,048.51	7,136.04	7,445.94	7,566.06	14,086.55	.....	73,466.43
14	3,647.04	4,093.42	— 3,166.49†	3,307.35	3,378.81	3,512.31	$980.92	26,974.01
15	2,690.81	2,888.54	— 2,433.17†	2,382.50	2,518.14	2,742.48	.....	20,056.82
16	201.13	249.40	247.18†	318.48	358.42	424.98	.....	2,018.05
17	26.77	26.77	26.97	27.16	27.16	27.42	.....	202.40
18	.18	.36	.36	.36	1.91	4.03	.....	7.20
20	1,800.30	2,546.28	2,228.67	2,575.93	2,800.25	3,109.45	472.32	19,999.89
21	68.25	219.32	14,912.17	4,144.99	4,483.55	4,867.83	.....	28,696.11
22	3,266.20	6,360.69	3,971.61	4,197.39	4,351.24	4,632.03	584.17	27,042.84
23	6,987.88	8,713.43	6,880.79†	7,573.82	7,444.08	7,494.27	966.03	85,910.29
27	75.62	76.92	89.89	102.93	102.91	102.91	.....	588.33
28	1,755.34	2,999.83	3,210.28	3,033.16	3,932.07	3,811.19	1,962.85	19,939.51
29	.38	2.01	3.27	3.27	3.27	3.27	.....	15.47
	$30,345.04	$41,740.67	$38,087.79	$40,520.48	$42,412.88	$50,348.32	$4,966.29	$369,360.20

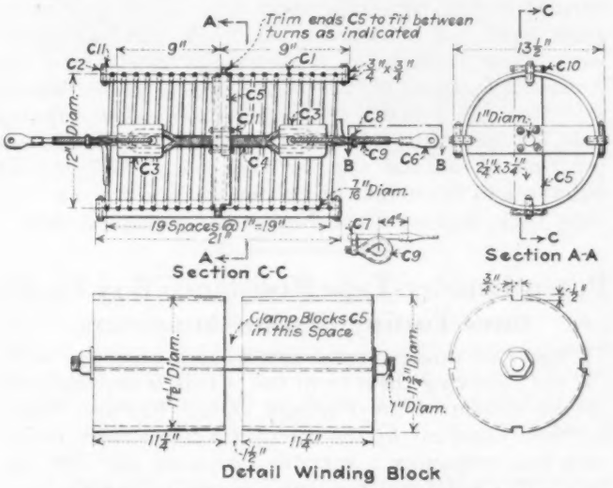
† These accounts were credited with materials used for services, transfer having been made to service account C-21.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Strain-Type 12,000-Volt Choke Coil Built on the Job

A STRAIN-TYPE choke coil built for service on 12,000-volt, 60-cycle lines carrying up to 150 amp. is shown in detail on the accompanying drawing. These coils were made in the fall of 1920 and the labor cost was approximately $20 for a set of three, while $4 per coil would probably cover all material costs. For appearance and service these coils equal the high-grade coils on the market which cost considerably more and on which the delivery is quite long. The coils are made of



DETAILS OF CONSTRUCTION OF 12,000-VOLT, 150-AMP. CHOKE COIL OF STRAIN TYPE

No. 00 B. & S. gage solid, semi-hard-drawn copper wire, not annealed. The wire was wound on two special wooden winding blocks 11¾ in. (29.8 cm.) in diameter and 11¼ in. (28.5 cm.) long, which are shown in the drawing. The blocks were slotted at 90-deg. intervals, ¾ in.

BILL OF MATERIAL FOR CHOKE COIL

Mark	No. Req.	Description	Material	Remarks
C1	85 ft.	2/0 B & S Solid bare wire	Copper	
C2	4	Wood clamps	Oak	See note below*
C3	2	Strain bobs	Porcelain	.....
C4	6 ft.	¼-in., galvanized messenger	Steel	Soft
C5	2	Cross-brace	Oak	See note below *
C6	2	Lugs for 2/0 wire	Copper	.....
C7	2	End clamps	Steel	.....
C8	2	Stove bolts, ¼ in. x ¾ in.	Steel	With nut for "C7"
C9	2	Thimble, ½ in. score	Steel	Galvanized
C10	4	Stove bol , ¼ in. x 3 in.	Steel	Two washers and nu:
C11	12	Stove bolt, ¼ in. x 1¼ in.	Steel	Two washers and nut

* Wood parts to be oven-dried and boiled in paraffin until bubbling ceases, after which they are painted with insulating varnish.

(19 cm.) wide and ½ in. (12.7 cm.) deep. Into these slots the inside strips of the clamps *C*2 were placed. The cross-brace *C*5 was mounted on a long bolt between the two wooden winding blocks. After the blocks were tightened on this long bolt by means of nuts the coil was wound on in a lathe. Before the tension was relieved on the wire the top half of the clamp *C*2 was bolted over the wire. The ends of the coil were brought down and clamped to the supporting wire which is attached to the insulators inside the coil. The line wire was then bolted on to the lugs which are shown at the extreme ends of the drawing. After assembling, all steel and copper parts were painted with three coats of insulating varnish. Before beginning the construction all wood parts were oven-dried, then boiled in paraffin until all bubbling ceased, after which they were painted with insulating varnish.

A. U. AVERA,
Assistant Engineer.
United States Engineer Office,
Florence, Ala.

Instructions for Fusing 44,000-Volt Transformers

CORRECT fuse sizes for 44,000-volt transformers and fusing currents of copper and climax wires are shown in the accompanying tables. Table I gives the fusing currents of copper wire in air based on the experiments of Preece. Although the fusing current is decreased somewhat by inclosing the wire in a tube, the values in this table are accurate enough for calculating the size of the fuse for different sizes of transformers. A wire carrying 75 per cent of its fusing current becomes red hot and gradually oxidizes so that it will fuse in from ten to thirty minutes. Therefore if a transformer is fused for double full load it will operate at

TABLE I—FUSING CURRENT OF COPPER AND CLIMAX WIRE IN AIR

Size of Wire, B. & S. Copper	Fusing Current, Amp.	Size of Wire, B. & S. Copper	Fusing Current, Amp.
0	1,895	24	30
2	1,340	26	22
4	940	28	15
6	670	30	10
8	470	32	7.3
10	325	34	5
12	240	40	1.7
14	165	Climax	
16	120	26	6.5
18	82	28	4.5
20	60	30	3.3
22	40	32	2.4

one-and-a-half load for ten to thirty minutes. For this reason transformers which are not otherwise protected should be fused for approximately double full-load current, but where the low-tension circuits from transformers are all protected by relatively small fuses the high-tension fuses can be increased to three times the full-load current and in special cases may be increased still more if the protection on the low-tension side is exceptional. The table of proper fuse capacity is based on twice normal current for transformers which are otherwise unprotected and three times normal for which they have relatively small secondary fuses.

The use of the ordinary lead-composition fuse wire

is not recommended for fusing high-voltage transformers, particularly at outdoor substations, because of its poor mechanical strength. There is, however, no objection to the use of composition or aluminum fuses in the small fuse tubes used with indoor potential transformers. For outdoor work the fuses should be tin-coated to prevent corrosion except in sizes as large as

TABLE II—PROPER FUSE SIZES FOR 44,000-VOLT TRANSFORMERS

Size of Entire Bank, Three-Phase, Kva.	Full-Load, Amp. at 44,000 Volts	Size Primary Fuse When Transformer Is Not Protected on Low-Tension Side	Size Primary Fuse When Transformer Is Protected On Low-Tension Side
100	1.3	32 Climax	30 Climax
150	2.0	28 Climax	26 Climax
200	2.6	26 Climax	32 Copper
300	4.0	32 Copper	28 Copper
400	5.2	30 Copper	28 Copper
450	5.9	28 Copper	26 Copper
500	6.6	28 Copper	26 Copper
600	7.9	28 Copper	24 Copper
750	9.8	26 Copper	24 Copper
1,000	13	24 Copper	22 Copper
1,500	20	22 Copper	20 Copper
2,000	26	20 Copper	18 Copper

No. 22 gage. The small spools of wire sold in hardware stores are not marked according to the B. & S. gage. Therefore fuse wire should be ordered from an electrical supply house specifying "tin-coated climax (or copper) No. — B. & S. gage fuse wire." P. P. Ashworth, Utah Power & Light Co. Distribution Engineer.
Salt Lake City, Utah.

Too Low Salt Concentration in Boilers Is Not Economical

Although it is desirable to reduce the salt concentration in boilers, too low a concentration may be costly on account of the heat wasted in blowing down the boiler. Not only is heat wasted but additional feed water must be purchased and additional scale-forming materials taken in, causing further loss of heat and expense for their removal. For instance, in plants of the Southern California Edison Company tests have

BLOW-DOWN LOSSES WITH DIFFERENT BOILER CONCENTRATIONS

Make-up water: 6 grains salt per gallon.
Condensate: 2 grains salt per gallon.

Sodium Chloride per Gal., Grains	Blow-Down per Lb. Condensate, Lb.	Fuel Wasted in Blow-Down, per Cent
50	0.0455	1.142
100	0.0213	0.537
150	0.0139	0.331
200	0.0103	0.261

Make-up water: 6 grains salt per gallon.
Condensate: 20 grains salt per gallon.

Sodium Chloride per Gal., Grains	Blow-Down per Lb. Condensate, Lb.	Fuel Wasted in Blow-Down, per Cent
50	0.455	10.35
100	0.213	5.12
150	0.139	3.40
200	0.103	2.55

Based upon steam at 225 lb. gage, 125 deg. Fahr. superheat; make-up water at 80 deg. Fahr.; condensate at 100 deg. Fahr.

indicated that a concentration of 200 grains of salt per gallon (3.4 grains per liter) is satisfactory as regards priming. However, a further reduction in concentration is not desirable. The most economical operation will result when there is the least amount of blow-down consistent with absence of concentration trouble. The losses involved in blowing down are shown in the table.

Thus it is seen that maintaining a low concentration such as 50 grains per gallon (0.8 grams per liter), instead of the maximum allowable of 200 grains per gallon, causes an additional fuel loss of about nine-tenths of 1 per cent when the condensate contains 2 grains (0.13 grams), which may be considered as normally good operation. With an increase in the salt in the condensate the fuel loss becomes extremely serious when low boiler concentrations are maintained. For instance, it is seen that with 20 grains of salt per gallon (0.34 gram per liter) in the condensate and a boiler concentration of 50 grains per gallon the loss is over 10 per cent
Southern California Edison Co. R. J. C. Wood,
Los Angeles, Cal. Electrical Engineer.

Linemen Should Not Try to Set All Insulators Vertically

One of the difficulties in sagging lines is to get the linemen to leave the insulators alone after the lines are sagged. Usually the insulators will not hang vertically and the linemen will change them so that this condition shall be obtained. As there is only one critical temperature at which the insulator will remain vertical it will be only a short time until it is at an angle again. J. S. Martin, Duquesne Light Company, made these remarks at a Pittsburgh meeting of the American Institute of Electrical Engineers. Mr. Martin said that the practice in his company, when sagging lines between towers of different heights, is to allow 1 per cent of normal sag for each 56 ft. (17 m.) of difference in the height of the towers.
New York, N. Y. Field Editor Electrical World.

Potentiometer-Type Resistance Box Facilitates Testing Station Ammeters

Testing direct-current switchboard ammeters without removing them from the boards is accomplished on the system of the Portland (Ore.) Railway, Light & Power Company by the use of a potentiometer resistance box containing a variable resistance and dry battery. This box furnishes both a source of energy and a means for gradually varying the voltage. As an ammeter is in reality a millivoltmeter connected to a shunt which gives a specified drop in millivolts for full-scale reading,

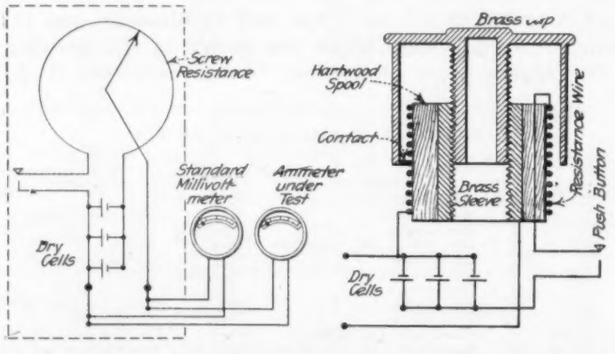


FIG. 1—USE OF SCREW-TYPE RESISTANCE FOR CHECKING SWITCHBOARD AMMETERS

the ammeter may be calibrated by comparison with a portable standard millivoltmeter. Therefore when testing the ammeter the leads are removed from the shunt and it is connected in parallel with the standard millivoltmeter as indicated in the drawing. The leads from both instruments are connected to the terminal posts of the resistance box. By turning the brass

screw cap the resistance is varied, and this changes the voltage on the meters as desired.

The resistance box consists of the screw resistance, the three flashlight dry cells and the push-button contact as shown. The screw resistance is made by winding bare resistance wire on a threaded hardwood spool mounted on a brass stem. The inside of this stem is threaded with the same pitch as the threads on the wooden spool. Into this stem is screwed a brass cap

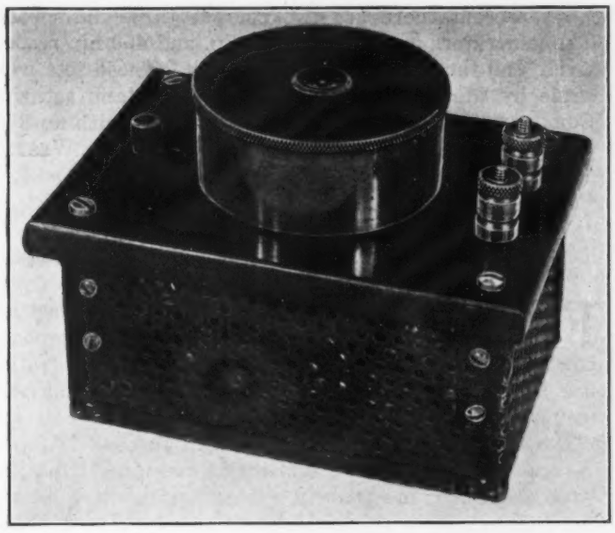


FIG. 2—SMALL PORTABLE RESISTANCE BOX FOR CHECKING SWITCHBOARD AMMETERS

with a contact point on the inside of its outer shell, and this point bears on the resistance wire. This contact follows the resistance wire as the cap is turned down and thus varies the resistance in the circuit and changes the voltage at the terminals. The instrument has a range of from 0 volt to 1.4 volts, using three dry cells.

As may be seen from the photograph, the screw resistance, binding posts and push-button are mounted on a hardwood top, while the batteries and circuits are inclosed in a perforated sheet-iron box.

Portland Railway, Light & Power Company, Portland, Ore.
P. E. ALGER, Laboratory Department.

Locating a Grounded Coil in an Alternator

TO LOCATE a grounded coil in an alternator without disconnecting any coils the test outlined here was employed recently by the writer. A 600-kva., 2,200-volt, two-phase alternator developed a ground of which there was no visible indication but which caused disturbance in a telephone system and radio station in the vicinity. To find the fault an ungrounded 110-volt alternating-current supply was connected directly to the terminals of the grounded phase, which drew 15 amp. at this voltage. One terminal of a 110-volt voltmeter was grounded to the frame of the alternator. The other terminal of the voltmeter was connected to an ordinary shoemaker's awl, the sharp point of which was used to pierce the insulation on the end connections of each coil in the grounded phase. Connection was made with each coil in turn, and readings of the voltmeter were noted. The coil showing the smallest reading was the damaged coil, but the voltmeter readings on three of the coils were so low that it was hard to determine which one of these three coils was the damaged one.

To locate the trouble more definitely an ordinary telephone receiver was substituted in place of the voltmeter. When contact was made with the grounded coil there was no noise in the telephone receiver. When contact was made with the coils on either side of the grounded coil the telephone could be heard several feet away. Consequently it was very easy to find the exact location of the damaged coil and remove it without disturbing much of the other windings.

G. R. SHUCK,
Department of Electrical Engineering.
University of Washington,
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Formula for Calculating Alternating-Current Voltage Drop

FOR determining the voltage drop on alternating-current circuits up to a length where charging current must be taken into account the accompanying formula has been developed by the writer. The factors which must be known are receiving voltage, length of line, resistance, power factor and spacing. The formula follows:

TABLE I—VALUES OF R AND X FOR DIFFERENT SIZES OF WIRE

Wire Size	R	X					
		Distance Between Centers, Inches					
		12	18	24	36	48	60
8	0.627	0.1256	0.1349	0.1415	0.1508	0.1574	0.1625
6	0.394	0.1203	0.1296	0.1362	0.1465	0.1521	0.1572
4	0.248	0.1150	0.1243	0.1309	0.1402	0.1468	0.1519
2	0.156	0.1097	0.1190	0.1256	0.1348	0.1414	0.1466
1	0.1237	0.1070	0.1163	0.1229	0.1322	0.1388	0.1439
0	0.0981	0.1043	0.1136	0.1202	0.1295	0.1361	0.1412
00	0.0778	0.1017	0.1110	0.1176	0.1269	0.1335	0.1386
000	0.0617	0.0991	0.1084	0.1150	0.1242	0.1308	0.1360
1000	0.0489	0.0964	0.1057	0.1123	0.1216	0.1282	0.1333

$$\text{Three-phase voltage drop} = \frac{\text{watts} \times L \times (Rp + Xs)}{Ep}$$

$$\text{Single-phase voltage-drop} = \frac{2 \times \text{watts} \times L \times (Rp + Xs)}{Ep}$$

L = length of line, in thousands of feet.
R = resistance in ohms per 1,000 ft. of one wire.
p = power factor.
X = reactance in ohms per 1,000 ft. of one wire (see Table I for values with different spacings).
s = value obtained from Table II to correspond with the given power factor.
E = voltage at receiving end.

TABLE II—VALUES OF s CORRESPONDING TO DIFFERENT VALUES OF p

p	s	p	s
1.00	0	0.75	0.66
0.95	0.312	0.70	0.71
0.90	0.436	0.65	0.76
0.85	0.526	0.60	0.80
0.80	0.60	0.50	0.867

The value s given in Table II to correspond to different power factors is the sine of the angle of lag and might be calculated from the equation $s = \sqrt{1 - p^2}$ in absence of Table II.

CHARLES E. WARSAW,
Burlington (Vt.) Light & Power Co. Engineer.

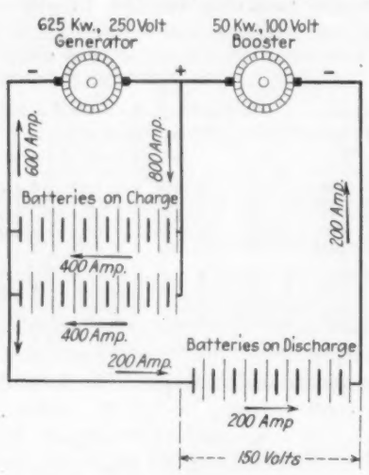
Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Booster Saves Energy in Charging Storage Batteries

AN ECONOMICAL method of charging and discharging storage batteries is in use in the Indianapolis plant of the Prest-O-Lite Company. It is accomplished by pumping the current from discharging batteries through batteries being charged by means of a booster. This operation greatly reduces the size of generator needed for charging.

Energy for charging is furnished by a motor-generator set which converts 4,100-volt, three-phase energy to 250 volts, direct current. The booster which is employed to allow the batteries to be discharged back into the line is mounted on the same shaft with the two other machines. In operation the batteries being charged are connected across the 250-volt generator in the regular manner, each having a suitable charging rheostat connected in series. The batteries to be discharged and the 100-volt booster are connected to the discharge circuit, as shown in the drawing. These batteries are connected in series with a booster which composes the third unit of the converting apparatus, it being a 100-volt direct-current machine. Assume that the batteries on discharge deliver 200 amp. at approximately 150 volts. This current passes through a rheostat and the booster. As the booster voltage is 100 volts the 200 amp. is pumped back at 250 volts into the 250-volt bus. Therefore with a current of 800 amp. flowing through the batteries on charge, only 600 amp. is delivered by the main generator because the discharge circuit is delivering 200 amp. to the charging circuit.



BOOSTER ALLOWS SMALLER GENERATOR TO BE USED FOR CHARGING

Thus with the addition of the boosting generator on the same shaft the effect is obtained of increasing the main generator size. Without the booster the 250-volt generator would have to deliver 800 amp. for charging or produce 200 kw. With the booster the generator will be required to deliver only 600 amp. or 150 kw. However, to raise the voltage of the discharging circuit to 250, 200 amp. at 100 volts must be produced at the booster machine. This amounts to 20 kw. Therefore the same number of batteries are charged with only 170 kw., neglecting the losses in the machines.

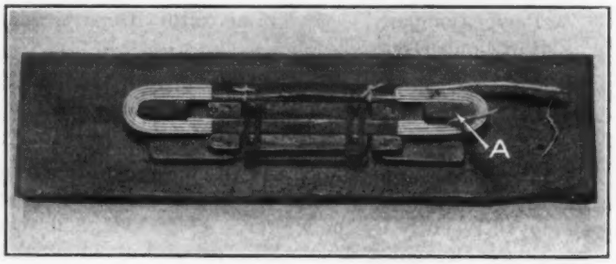
At present there are two sets of three units each. The generators are rated at 625 hp. and 450 hp. respectively and the boosters at 50 hp. each. These sets were made by the Westinghouse Electric & Manufacturing Company. In the near future another set with an 875-hp. generator will be installed. L. R. WEST.

Indianapolis, Ind.

Block for Insulating Coils Before Placing in Motor

FOR tying slot insulation on to coils before they are put into the slots of motors or generators, a wooden block such as shown in the accompanying illustration has been made by the writer. This block enables the insulation to be wrapped snugly around the coil and tied so that it will not be loose when the coil is taped. To use the device, the insulation is cut into strips just wide enough to make about a turn and a third around the coil. A strip is placed into the long groove which is just the shape of an armature slot. The coil is put in on top of the strip and the overlapping insulation is folded over. The two slotted metal pieces are then slipped over the insulation and are held in place by two screws as shown. Then the insulation is tied around the coil by threading a length of twine underneath the coil through the small slots by means of a curved sack needle. If it is desired, tin clips may be used for holding the insulation in place instead of tying it with the twine. The writer has tried several methods and prefers to tie with the twine.

A further purpose of this device is to indicate the position on the coil for the cotton sleeving emerging from the tape. This is done by marking the position



INSULATION IS HELD UNDER SLOTTED BARS WHILE BEING TIED IN PLACE

on the base of the device at the point indicated by the arrow where a line is painted. When the coil is placed in the groove a blue pencil mark is drawn across the coil, thus indicating to the taper where to bring out the sleeving. As a usual thing about 1 in. of the sleeving is taped in.

Such a device is cheap and easily made and a separate one is used for each size of coil. L. E. WOOD.

Glasgow, Scotland.

Electric Logging Equipment Adopted by Snoqualmie Company

ELECTRICALLY driven logging apparatus is being successfully used in the forests of Washington by the Snoqualmie Falls (Wash.) Lumber Company. This company has for this work in the woods a yarder and a loader mounted on the same sled and a portable substation on a separate sled. The yarder is a Willamette Iron Works Humboldt three-drum device, having for motive power a General Electric 200-hp. phase-wound induction motor used on a three-phase, 60-cycle, 550-volt power circuit. The loader, also built by the Willamette Iron Works, is equipped with two General Electric 75-hp. phase-wound induction motors. The two machines each occupy half of a 60-ft. sled, which renders them portable.

The power supply for the two machines is stepped up to 13,200 volts at the mill power plant by three 250-kva. transformers transmitted through the woods, and is stepped down to operating voltage by two 250-kva., single-phase, 600/13,200-volt transformers on the scene of operations. The transformers are rendered portable by being mounted on a small sled, which is equipped with a disconnecting switch. This sled is set about 500 ft. distant from the one carrying the yarder and loader, energy being transmitted between them by a flexible armored cable laid on the ground.

Some difficulty was experienced at first in obtaining desired low speeds on the yarder, but this was overcome by the insertion of resistance in the phases of the rotor. In 1918 the machine yarded 3,144,898 ft. of timber in forty-four days, or an average of 71,470 ft. per day. In 1919, owing to increase in the transformer capacity, the average per day was raised to 77,000 ft. The same efficiency which characterizes the operation of the yarder is demonstrated by the loader. The application of solenoid load brakes to the motor makes it as successful as a steam-driven outfit. It is also possible by means of this braking system to do one thing which a steam outfit cannot do, namely, to hold a log suspended in mid-air or in any position desired. This is made possible by the fact that when power is shut off from the motor the solenoid brake sets automatically, so as to prevent any motion.

The good results obtained by electrifying the logging operations are the most convincing argument possible in favor of the electrification of the logging industry generally. Methods that increase production and cut costs are as valuable in lumbering as in any other industry and deserve consideration by those interested.

FIELD EDITOR ELECTRICAL WORLD.

San Francisco, Cal.

PORTABLE TRANSFORMER SUBSTATION HAULED INTO THE WOODS

LOGGING IN THE FOREST WITH ELECTRICALLY DRIVEN YARDER AND LOADER MOUNTED ON ONE SLED

Fifty-Ton Sulphite Paper Mill Requires 1,500 Hp. in Motors

AN ANALYSIS of the load requirements for a sulphite pulp mill rated at 50 tons per twenty-four hours has shown that the total rating is approximately 1,500 hp., 400 hp. of which is required for the wood-preparing room, from 175 hp. to 200 hp. for the yard and slasher mill, 77 hp. for the acid plant, 50 hp. for the cooking department, 130 hp. for the washing or blow pit department, 175 hp. for the screening department, 233 hp. for the bleach department and 35 hp. for the finishing or wet machine room. Table 1 gives a full list of the motors in each department, together with the maximum and average load. It will be noticed in connection with the screen department that the total connected load is 711 hp., while the load charged to this department is only 175 hp. This difference is due to the 400-kva. synchronous motor used for power factor connection.

For the most part, the motor loads are not periodic, but are based on fluctuating conditions, which in some cases occur at regular intervals. Each department, however, has certain motor-load conditions which can be analyzed by following the processes through. Wood is brought to the mill yard both by rail and water. The rail handled wood is piled in the yard until used, while the water-handled wood is boomed at the slasher mill, which consists of a two-gang circular saw capable of handling 125 cords of 8-ft. wood per day of ten hours. The wood is sawn in 4-ft. lengths.

The power required for the slasher mill is shown on chart *A* of the load charts. The load is seen to be fluctuating, and the maximum power never exceeds the rated capacity of the motor. However, the saw deck is equipped for a third saw to be used on 16-ft. wood.

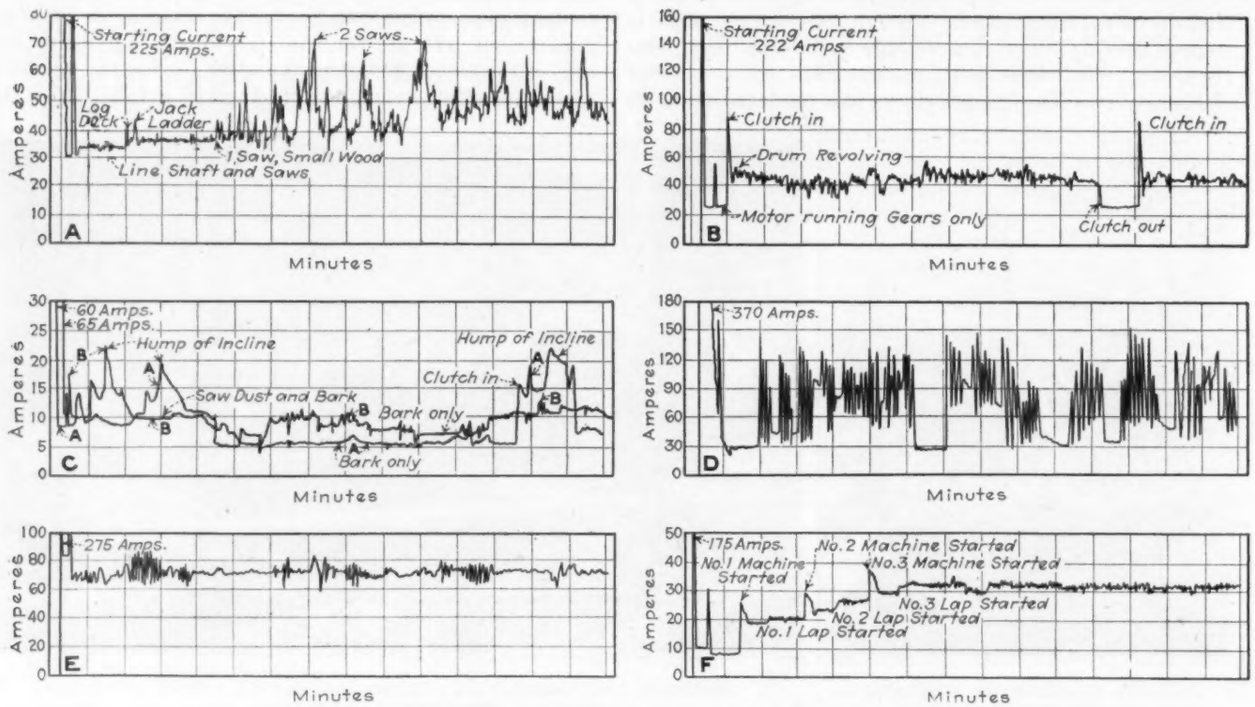
and when this is used the average power will be somewhat greater. From the slasher mill the wood is conveyed to the mill or yard, as the case may be, by a 275-ft. cable conveyor supplied by a 35-hp. motor. The average power is only 22 hp. and is practically uniform. The power required per foot of conveyor is 0.08 hp. The conveyor is inclined, which accounts for the high rate per foot. For conveyors of different types the writer has found from experience that the power range is from 0.043 to 0.09 hp. per foot of conveyor. After leaving the 275-ft. conveyor the wood is either taken direct to the mill or to the storage yard. The wood sent to the mill travels over a 200-ft. and a 50-ft. conveyor driven by a 15-hp. motor and a 170-ft. conveyor driven by a 20-hp. motor. The average power required for the 15-hp. motor is 12½ hp., while the highest point reached is 17 hp. This motor starts with an idle pulley, and the load is thrown on by a friction pulley. The 20-hp. motor has an average load of 12½ hp. and the load is fairly uniform. The wood going to the storage yard travels on a 500-ft. conveyor operated by a 50-hp. motor. This is a double conveyor; that is, the wood travels both ways. The wood pile is in the shape of a horseshoe with a wet pile on one side and a dry pile on the other. The average power consumed by the outgoing wet wood is 25 hp., while the average with incoming dry wood at the same time is 40 hp. It will be noticed that there has been a tendency toward overmotoring. The reason for this is to overcome the necessity of increasing the motor sizes when the conveyors are completed, as at the present time they are built to be extended. A feature in connection with the motor on the 500-ft. conveyor is that it is automatically operated with a magnetic breaker and push-button stations situated along the conveyor and in the wood room. From the 500-ft. conveyor the wood is piled by a portable stacker operated by a 10-hp. motor, the operating characteristics of which are shown in chart *C*. The rest of the yard equipment consists of two portable 10-hp. conveyors and a portable 10-hp. slasher saw. The combined connected load of the yard is 205 hp., shown in detail in the table. The wood-preparing room equipment consists of barking drums, conveyors, screens and chippers.

The power required for the barking drums, of which there are two, is shown in chart *B*. Chart *C* shows the load of a 10-hp. motor hauling coal and refuse to the boiler house under various conditions.

After being barked and washed the wood is conveyed to an 84-in. chipper driven by a 100-hp. motor at 580 r.p.m., with a fluctuating load as shown in chart *D*. The larger chips and slivers are crushed by a Lombard crusher. From the wood room the chips are conveyed on a 300-ft. belt conveyor by a 20-hp. motor, the load of which is constant. The total connected load of the wood room, including a 40-hp. pump, is 400 hp., details of which are given in the table.

The total connected load of the acid-making department is 80 hp. There are four 10-hp. acid-circulating pumps, two having an average load of 8 hp., one an average load of 7½ hp. and one an average load of 10 hp. Another 10-hp. motor pumps the acid to the storage tanks with an average load of 10 hp. and the same operating condition as the others. The gas is kept in circulation by two fans, one on the intake and the other on discharge. Both fans are driven by 10-hp. motors. The limestone rock is elevated by a 10-hp. motor. For more details in connection with the power requirements the table may be referred to.

The only power used in the digester building where the cooking takes places is a 50-hp., 1,150-r.p.m. motor



AN ANALYSIS OF MOTOR-LOAD CONDITIONS IN A SULPHITE PAPER MILL

A.—Slasher mill driven by a 75-hp. motor. There are two 4-ft. circular saws, 20 ft. of eight-chain lag deck and 40 ft. of four-chain jack ladder. Average horsepower for the installation is 45. B—Barking drum driven by a 60-hp. motor, the average horsepower being 45. C—Refuse conveyor driven by a 10-hp. motor. The curve A is for mild weather and no sawdust, and curve B is for zero weather and conveying both sawdust and bark. D—An 84-in. chipper driven by a 100-hp. motor. E—Single-stage bleach-engine pump driven by 75-hp. motor. Average load, 72 hp. F—35-hp. motor driving three Rogers wet machines. Average hp., 28.

directly connected to a pump for pumping the acid from the storage tanks to the digesters. The digesters are two in number, of 16-ton capacity each. It takes from eight to twelve hours to cook a digester, and it takes about twenty minutes each time to fill a digester with acid.

From the digesters the pulp is blown to the wash or blow pits, where the liquor is removed and all gases allowed to escape. There are three motors in this department. A 20-hp. motor runs the knot screen above the riffler. The load is virtually constant. The second motor is rated at 35 hp. and drives a pump conveying the pulp to the screens. This motor is started and stopped frequently, and the operating conditions are severe, although the load is not heavy. The third motor is rated at 75 hp., 1,800 r.p.m., and drives a single-stage pump pumping white or used water from the machines to the blow pits and riffler. This motor carries a heavy overload.

The screens are in four lines of nine flat screens each. The power is taken from the 400-kva. synchronous condenser to the line shafting. The power requirement is 75 hp. at 76 per cent leading power factor. The water is pumped by a 75-hp., 1,800-r.p.m. motor using white or used water. A 25-hp., 1,800-r.p.m. motor pumps the stock from a "save-all" to the stock chests. The load on this motor is light as the amount of stock is light, the average load being 10 hp. The "save-all" is operated by a 5-hp. motor. There are in addition two 35-hp. pumps with characteristics identical with those shown in chart *P*.

The bleachers are large steel tanks of 16,898 gal. capacity each. The bleaching is done by heating the pulp with live steam, mixing it with chlorine liquor and keeping it in a whirling motion. This is done by a centrifugal pump driven by a 75-hp., 1,150-r.p.m. motor. The load characteristics are shown in chart E. The bleach pulp is pumped from drainer tanks of 28,163 gal. capacity to the screen by a 35-hp., 1,150-r.p.m. motor. Another 35-hp. motor with the same characteristics pumps the pulp from the stock chests to the machines. A 35-hp., 860-r.p.m. motor drives the agitators for the four stock chests from line shafting. These stock chests are circular wooden tanks of 25,635 gal. capacity each. The bleach powder is mixed in a steel tank of 4,712 gal. capacity by an agitator driven by a back-geared 3-hp., 720-r.p.m. motor, the average load of which is 2½ hp. The load on this motor is constant, and the duty is severe owing to particles of powder coming in contact with the windings and dissolving. This motor is housed in a copper hood and ventilated by two air ducts from the outside air. The weak liquor is pumped from the mixing tank by a 5-in., 1,800-r.p.m. motor driving a pump delivering 250 gal.

ACTUAL LOAD CONDITION CHECKED AGAINST MOTOR RATING

	Motor List					Pump List			
Dept.—Duty	Rated, Hp.	Max. Load, Hp.	Ave. Load, Hp.	Speed	Drive	Head, Ft.	G.P.M.	Intake, In.	Discharge, In.
Acid plant:									
No. 1 tower	10	8.25	8	1,760	Direct	56	300	5	4
No. 2 tower	7.5	7.75	7.25	1,760	Direct	56	300	5	4
No. 3 tower	10	10.125	10	1,760	Direct	56	300	5	4
No. 4 tower	10	8.125	8	1,760	Direct	56	300	5	4
Acid storage	10	12	10	1,760	Direct	50	300	5	4
Exhaust fan	10	12	10.5	1,160	Belt	...	....	..	..
Booster fan	10	12	9	590	Belt	...	....	..	..
Elevator	10	6	5	1,160	Geared	...	....	..	..
Total	77.5								
Digester Blow Pit:									
Acid pump	50	65	63	1,160	Direct	68	1,500	8	8
Stock pump	35	24	22	1,160	Direct	40	900	6	6
White water pump	75	108	90	1,760	Direct	135	1,500	10	8
Knot screen	20	23	21	860	Belt	...	....	..	..
Total	130								
Bleach:									
Stock pump	35	24	22	1,160	Direct	40	900	6	6
No. 1 beater engine	75	87.5	72	1,160	Direct	40	3,000	12	10
No. 2 beater engine	75	87.5	72	1,160	Direct	40	3,000	12	10
Drainer pump	35	50	40	1,160	Direct	40	900	6	6
Weak liquor	5	6.125	6	1,760	Direct	20	375	5	4
Strong liquor	5	5.5	3.5	1,760	Direct	20	375	4	3
Agitator	3	3	2.75	720	Back gear	...	....	..	..
Total	233								
Screen:									
Screens	536*	100	75	600	Belt	...	....	..	..
White water pump	75	105	90	1,760	Direct	135	1,500	10	8
Unbleach pump	35	25	22	1,160	Direct	40	900	6	6
Agitator	35	40	37.5	860	Belt	...	....	..	..
"Save-All"	5	3.125	3	1,760	Belt	...	....	..	..
"Save-All" pump	25	11	10	1,760	Direct	40	750	5	5
Total	711								
Machine:									
Main drive	35	32	285	860	Belt	...	....	..	..
Wood room:									
Chipper	100	125	90	590	Belt	...	....	..	..
Crusher	20	50	15	590	Belt	...	....	..	..
Log conveyor	20	20	17.5	590	Belt	...	....	..	..
Log conveyor	10	15	12.5	590	Belt	...	....	..	..
Chip conveyor	20	20	17.5	590	Belt	...	....	..	..
Chip conveyor	10	15	10	590	Belt	...	....	..	..
Screen	20	18	17.5	590	Belt	...	....	..	..
No. 1 barker	60	55	45	576	Belt	...	....	..	..
No. 2 barker	60	45	40	860	Belt	...	....	..	..
Machine shop	20	30	17.5	590	Belt	...	....	..	..
Refuse conveyor	10	22.5	10	590	Belt	...	....	..	..
White water pump	40	25	18	1,760	Direct	135	800	6	6
Total	390								
Yard:									
No. 1 conveyor	35	25	22	860	Belt	...	....	..	..
No. 2 conveyor	50	30	25	1,160	Belt	...	....	..	..
No. 3 conveyor	15	25	14	860	Belt	...	....	..	..
Stacker	10	7	6.25	590	Belt	...	....	..	..
Slasher saw	10	25	6	590	Chain	...	....	..	..
No. 1 portable conveyor	10	....	....	1,160	Belt	These motors can only be used occasionally			..
No. 2 portable conveyor	10	....	....	1,160	Belt				..
Total	140								
Main drive:									
Slasher mill	75	70	45	860	Belt	...	....	..	..
Totals	46 1,841.5	1,498.5	1,176.75		.....				

* Sync. condenser, power-factor correction.

per minute, and the strong liquor is pumped by another of the same size and capacity. The average load on the first is 6 hp., while on the second it is 3 hp. The load on each is practically constant.

There are three wet machines line-shaft-driven by a 35-hp., 860-r.p.m. motor, with the line shafting alone and with one, two and three machines. The load is irregular as all three machines are usually not running at one time.

H. E. STAFFORD,
Provincial Paper Mills, Ltd., Electrical Engineer.
Port Arthur, Ont.

Motor with Short-Circuited Slip Rings Will Not Start

AN ATTEMPT to convert a slip-ring motor to a modified squirrel-cage machine by removing the rings and short-circuiting the three leads was not successful because the motor would not always start, although not loaded. A slip-ring rotor is designed with a very low internal resistance as it is intended to be started with external resistance connected across the slip rings, and when the rotor winding is short-circuited, as was the case here, the motor does not have sufficient internal resistance to give the starting torque to start the rotor when in certain positions. The trouble can be corrected only by replacing the slip rings and connecting sufficient external resistance to give the required starting torque. It is possible to increase the starting torque of a slip-ring motor by short-circuiting only two of the rings during the starting period and then short-circuiting the three rings before the motor reaches half speed. This, however, does not as a rule give sufficient torque to start any load.

In many induction motors, and especially those of the slip-ring type, the starting torque varies with changes in the angular position of the rotor, thus producing high and low torque points. If the starting torque of the motor is high, these low-torque points are not noticeable, as the motor has sufficient torque even at the low-torque points to start the motor and load. If, however, the starting torque is very low, a condition may be reached where the torque is just enough to start the rotor at the high-torque points but not great enough at the low-torque points.

Among the factors influencing this low-torque point is the ratio of the number of stator and rotor teeth. If the number of stator and rotor teeth is very nearly or quite the same in most extreme cases, there will be a considerable variation in the average magnetic reluctance over a pole as the rotor teeth come in line with the stator teeth in one position or in line with the stator slots in another position. This variation in reluctance causes a variation in the average main flux over a pole and also causes the leakage flux to vary in such a way that the effects of the two fluxes combine to give a high torque when the teeth are in line and a low torque when the teeth and slots are in line. This condition is remedied by choosing the ratio of primary and rotor teeth so that there will be the least possible variation in the average magnetic reluctance over a pole as the rotor moves. Skewing the rotor one slot pitch also remedies this condition.

Another cause of low-torque points is an unequal distribution of flux caused by the chording and unequal grouping of the windings, irregularities in the magnetic circuits and the resultant harmonics. These conditions are more noticeable in wound-rotor motors than in squirrel-cage motors owing to the fact that in a wound rotor a number of the coils are in series, thus preventing the flow of corrective currents from one part of the winding to another, while in a squirrel-cage rotor all the conductors are in parallel, thus permitting the flow of corrective currents.

R. H. N. LOCKYER.
Trail, B. C., Canada.

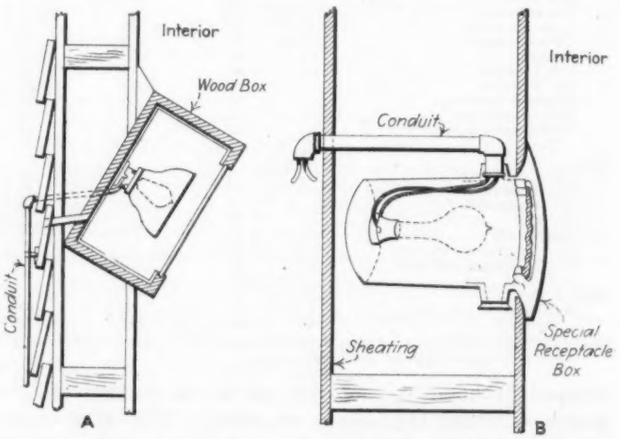
Bending a Large Cable to Fit Close Quarters

FITTING a large cable in close quarters is a job which can be made less difficult by using a strip of solder to measure the length and the shape of the bend. The solder, being easily bent, can be worked into the exact place the cable will occupy. After removing the solder it is straightened, and the cable can then be cut accurately from this piece of solder as a measurement, allowing for the cable being thicker than the solder. By taking the strip solder again and shaping it to the place the cable will occupy, then shaping the piece of cable to match, a very neat and workmanlike fit may be obtained.

HERBERT G. STODDART.
East Orange, N. J.

Safe Lighting Fixtures for Powder Plants and Munition Houses

THE wiring of powder plants, munition warehouses and similar buildings should be on the outside of buildings, preferably exposed for easy inspection, while the lamps themselves should be inclosed. Two lighting fixtures used in such plants are shown in the accompanying drawing. One large explosive plant uses an asbestos-lined box, such as shown at *A*, containing the lamp, reflector and receptacle. The whole box is set in the building wall at an angle depending upon the machine to be illuminated. Occasionally in a particularly dangerous location, such as in parts of flour mills, powder mills or where corrosive-acid fumes are prevalent, a metal receptacle box is set into the wall partition as shown at *B*. The glass front of this receptacle safely protects the lamp and may be removed when changing it. Ventilation is provided by the air which circulates through the conduit.



SPECIAL FIXTURES FOR LIGHTING ACID PLANTS AND POWDER MILLS

Westinghouse Lamp Company, SAMUEL G. HIBBEN,
Bloomfield, N. J. Consulting Illuminating Engineer.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Booklets for Helping in the Sale of Securities

"THE Tale of Two Hundred Cities" is the title of a sixteen-page booklet published by the Public Service Company of Northern Illinois to assist in the sale of its securities to its customers. An interesting story is told about the company, the extent of its properties and the diversity of interests served, and a few figures are given to show the growth of the business and earnings of the company. The pages are so filled with maps and attractive photographs that the actual text filis only about six pages.

"The Giant of the Valley" is the manner in which the Missouri Gas & Electric Service Company designates itself in a booklet which has been used to encourage its customers to purchase its securities. The booklet is profusely illustrated, and the interesting photographs of different institutions and sections of the district outnumber many times the illustrations of the company's properties. A human-interest story which is not too long points out what electric service has done and can do for the communities served.

Employee-Investors Build Thrift and Good Will

By George H. Stack
Treasurer Utica Gas & Electric Company, Utica, N. Y.

INTEREST in profit sharing, stock ownership and similar plans for the promotion of thrift education is nation-wide. The development among workers everywhere of a feeling of proprietary interest in, and as a natural corollary a sense of loyalty to, the business which employs them has become the serious concern of all large employers. The Utica Gas & Electric Company recently closed a successful sale of its 7 per cent cumulative preferred stock to employees on a deferred-payment plan which resulted in a large percentage of employees becoming stockholders.

The par value of the stock is $100 per share, and it is preferred both as to assets and dividends over the common stock. The deferred-payment plan calls for full payment in two years, at the rate of $1 per share per week, or in one year at the rate of $2 per share per week. Employees on the semi-monthly payroll pay monthly in amounts equivalent to the weekly rate.

The sale opened Dec. 6 and continued for two weeks to Dec. 20, 1920, reaching a total of $90,600. This amount was subscribed by 377 out of 513 permanent employees. When the total for the first day's sales mounted to $33,000 the success of the sale was assured. Each succeeding day added a goodly quota, but even the feeling of optimism created by a rising barometer did not prevent the result from exceeding the best hopes.

The company had long been desirous of evolving some plan suited to local conditions for educating and encouraging its employees in the way of systematic saving and safe investment. When an issue of preferred stock was first contemplated, about a year ago, it seemed that here was the opportunity, primarily, to encourage in a practical way habits of thrift among employees and, secondarily, to enable them to acquire a financial interest in the company.

Preliminary Survey of Employees' Attitude

Cards of inquiry were sent out in April of last year to ascertain whether or not employees would be interested in subscribing for this preferred stock on easy-payment terms in the event that it was decided to put out the issue. The response was almost unanimously in the affirmative. This was most reassuring because there had been some misgivings as to the general attitude of the employees toward the plan.

Soon after the issue and sale of the stock was authorized by the Public Service Commission, Second District, a circular letter was sent to all employees announcing the fact and inviting them to think the matter over and be ready when an employee-solicitor should call for their subscription. Meanwhile a selling organization had been formed, composed of six teams, each with a captain and from two to eight solicitors, according to the number of names assigned to each team. The total number of solicitors was eighteen, all employees. At the beginning of the second week of the sale a second circular letter was addressed to employees who had not then subscribed, pointing out the value of the saved dollar over the spent dollar, emphasizing that once started right the incentive of seeing their fund grow is pretty sure to keep them at it, and stating that the company was desirous of as wide a distribution of stock as possible among employees, both because economic conditions make it highly desirable that a spirit of saving and safe investment be developed among workers everywhere and because it was glad of the opportunity to enable them to become, with its other stockholders, joint owners of the company and to share in its business. This circular was effective in speeding up the sale and a considerable factor in making it a success.

The number of shares likely to be sold was uncertain. While the response to our inquiry addressed to employees had been favorable, nearly eight months elapsed between the date of the questionnaire and the opening of the sale, and there was no way of measuring any change of sentiment which might have taken place in the meantime. We knew of only one similar sale in a city comparable in size and general conditions to Utica. In that case $50,000 of the company's preferred stock was sold to employees in a two weeks' campaign. With that total in mind we set up a bogey of $100,000 to shoot at. The sale of $50,000 would have been considered a success, and a total of $75,000 was all we really

dared hope for, though, of course, we urged on our various teams the necessity and the possibility of making bogey. The result was quite beyond our real expectation. That nearly 75 per cent of our total employees are now stockholders or prospective stockholders is a gratifying expression of faith in the company's future and denotes a feeling on the part of these employees that they have been getting and will continue to get "a square deal." It is also a most favorable commentary on the progress of thrift education among them.

LARGE NUMBER OF CASH SALES

A most encouraging feature of the campaign was the amount of stock sold for cash. It was evidence that the practice of thrift had already become a habit with many of our employees. Another of the surprises was the class of employees which made the largest cash purchases. One mechanic paid $1,500 in cash and subscribed for $500 on installment. A janitor in one of our plants produced a check for $1,000 and is seriously considering taking another $1,000. Another employee brought in $800 in greenbacks, and many others paid cash in varying amounts. These examples of preparedness had their effect in encouraging other employees to join the company's thrift club.

One peculiar thing in connection with the sale was the fact that while in drives of this nature the sales are usually made on an ascending scale, beginning with small sales and increasing day by day as the campaign progresses, our sale was on a descending scale, opening with a total of more than $33,000 the first day and gradually decreasing to smaller amounts as the sale neared its close. This, we believe, was due to the confidence of our men in the company's securities and their desire to take advantage of the opportunity to purchase stock on the easy terms offered.

The company is now preparing to offer preferred stock to its customers on a cash and deferred-payment plan. The latter plan calls for a 10 per cent cash payment with subscription and 10 per cent monthly for nine months. Not more than ten shares are to be sold to any customer on deferred payments.

Bonus Yields 6,000 Meter Readings per Man per Month

MORE than 27,000 meters a month were read by the meter-reading force of the Worcester (Mass.) Electric Light Company in November, 1920. A bonus system is used to such good effect that during that month three men attained $40 extra pay each, with lesser payments to the others of the force. The regular meter readers attained a maximum of 6,000 per month per man, when a recent rerouting was completed. Meter readers are paid on the following weekly basis:

First year, first half	$13.00	First year, second half	$14.00
Second year, first half	15.00	Second year, second half	16.00
Third year, first half	17.00	Third year, second half	18.00
Fourth year, and after	19.00		

Rates change in January and July, and the following bonus is added:

A bonus of $40 per calendar month is paid to each reader, except for the deductions noted.

There is subtracted from the total amount of the monthly bonus $1 for each mistake made, $1 for each morning the reader is late and $1 for each time a customer complains of the reader's conduct. If any meters are skipped, $1 is deducted from the bonus for each day when this takes place.

A bonus of $25 per calendar month is paid to each spare reader under the above conditions, except that spare readers are not penalized if all meters in the route are not visited.

The bonus is paid on the first pay day in the second month after it is earned, but a reader who is discharged for any reason or who voluntarily gives up his position does not receive any bonus other than that due on his regular pay day. Meter readers are paid $5 for each discovery of theft of energy, including all cases of unmetered current, and are paid $3 for each discovery of a meter in use without a meter-reading card.

What and Why of the Coal Clause Explained to Customers

WHY an electric light and power company must apply a fuel clause to its existing rates and how this application is made is explained as follows by the Rockingham County Light & Power Company of Portsmouth, N. H., in a bulletin sent to customers:

The coal clause that is applied by this company to the power and heat rates has become very general throughout the country where electrical energy is produced by coal and, although little understood by the average customer, is the fairest method of proportioning costs that has been conceived.

The original rates of every light and power company were based on some well-established cost of coal. With this company that price was $3.50 per ton. In 1916 our average cost of fuel per kilowatt-hour was $0.0046. This was an average of 2.6 lb. of coal per kilowatt-hour. Contracts with manufacturers and other public utilities were made prior to this time on very close margins of profit, for, needless to point out, we could not have secured their business otherwise.

In 1917 the average cost of coal per ton was $8.45, or $0.0094 per kilowatt-hour, making an increase in our coal bill for the year of $112,244.55. In 1918 the average cost per ton was $9.10, or $0.0129 per kilowatt-hour, an increase of $184,613.15 as compared with 1916. In 1919 the average cost per ton was $10.05, or $0.0130 per kilowatt-hour, and an increase of $192,579.69 as compared with 1916. You will note that the cost per kilowatt-hour did not increase this year in proportion to the increase per ton on account of a better average economy for the year.

These figures show what happens when we are compelled to pay high prices for coal, and, as it is generally conceded that prices cannot continue at this level, no company has tried to redesign its general rates on present coal costs. If the highest cost of coal were taken as a basis, the rate would be prohibitive. If the average cost of coal were taken, no commission would stand for a high enough price to keep the company from bankruptcy in case it had to buy some coal at $20 to $22 per ton, as we did in the months of July and August.

Hence the coal clause, which is designed to pass on to the rates to which it applies all the costs incident to the coal burned to produce that particular energy over and above what it would have cost had the company been able to buy coal at $4 per long ton.

Our records, taken over a long period, show that 1 cent variation in the price of coal results in a change of $0.00015 in our cost per kilowatt-hour, which is equivalent to 1½ mills per dollar.

So we have the coal clause, which is as follows:

"The price for each kilowatt-hour of electricity delivered under any contract or class of service to which a coal clause is applicable shall be subject each month to an addition or deduction, as the case may be, of fifteen one-thousandths

($\frac{15}{1000}$) of a mill per kilowatt-hour for each and every cent of variation in the price of bituminous coal of 14,500 B.t.u., above or below the price of $4 per gross ton in the company's coal bunker, this price to be determined by obtaining the average cost (after making any necessary adjustments for heating values) of all coal on hand on the first day of each month and all coal received during such month, together with interest at the rate of 6 per cent per annum on the cost of all coal in storage on said first of the month, it being understood the 'cost' shall include all charges for transportation, carting and handling, expenses and losses, if any, incident to placing the coal in storage."

We have been criticised by some on the ground that, with this coal clause, we did not care what we paid for coal. This is not true, for, if we were inclined to be indifferent to our customers' interests, the fact remains that the lighting rates carry no coal clause adjustments, and also the railroads, owned by the same interests that own this company, pay more than one-half the amount received from the coal clause.

There is ample justification for an increase of basic rates of more than 15 per cent (which we made in January), because of the unanticipated advances in wages, cost of apparatus, supplies and all operating expenses, as well as higher interest rates, all incident to or following the war, and the purpose of this article is to explain and justify the increase of monthly billing on account of the coal costs alone, which are not generally understood.

Recommendations for Better Merchandising by Central Stations

FOR the betterment of conditions prevailing in the sale of electrical merchandise by central stations, the merchandising committee of the Southeastern Section of the National Electric Light Association, at its convention in Miami, Fla., made the following pertinent recommendations:

1. Co-operation; closer relationship between the central station and the contractor-dealers.
2. Positive policy of price maintenance.
3. Extensive educational campaigns, using all possible manufacturers' literature.
4. Keeping of actual records showing the cost of doing business.
5. Discontinuance of the loaning of appliances on trial basis.
6. Co-operation with manufacturers and jobbers with a view to educating young men to be used in commercial departments of central stations.
7. A committee to interview motor manufacturers to obtain better discounts for the central station than those allowed to individuals.
8. A committee to interview lamp manufacturers requesting that the exclusive agency for lamps be given to the central station, in order that department stores and hardware stores may be excluded, because of the fact that they cannot intelligently recommend lamps of the proper voltage and the further fact that they are inclined to cut prices.
9. A campaign to interest all central-station representatives in becoming better acquainted with the electrical industry by the use of information supplied by the manufacturers, by reading trade journals, taking N. E. L. A. courses and in other ways identifying themselves more closely with the industry.
10. Special attention to appearance of showrooms in regard to neatness and attractiveness.
11. That a department be organized and maintained in each company for handling all repair work and trouble, in order to give the best service possible.
12. That, in addition to regular electrical appliance stocks, a line of kindred stocks be carried, including ironing boards, automobile lights and accessories, silk shades, portable lamps, fire extinguishers, miscellaneous electric supplies, extension cords, mechanical toys and numerous other non-energy-consuming devices essential to the complete electrification of the household.
13. Endeavor to do more advertising and in better style.
14. That individuality be displayed in national, state and local advertising in newspapers, windows and showrooms.
15. A committee to be appointed to see that the best deliveries and discounts are had from manufacturers, thereby assuring the largest margin of profit possible.

A Human-Interest Security Sales Appeal

Place An Income in Your Baby's Arms
ON Christmas morning a penny whistle would make a much better hit with baby than a $10.00 savings investment certificate of the Illinois Northern Utilities Company.
But think ahead a little. Vision baby as a straight shouldered, clean young man of college age, or a sweet faced girl on her eighteenth birthday. Then suppose that on this occasion you presented him or her with $4,082.00; and that this $4,082.00 really came about because you placed a piece of paper in your baby's arms on Christmas day, 1920.
Yet this is exactly what your Christmas gift to baby will represent, if you are willing to save $10.00 a month for your baby and invest it on the savings plan in this Company. Don't you think this plan is worth your most careful consideration?
Full details may be had at our Investment Department
Investment Department
Illinois Northern Utilities Company
Dixon, Illinois

Electric Service in Home Saves 84½ Eight-Hour Days per Year

HERE is a list of the most popular household electric appliances showing in eight-hour days the amount of time each device will save the user in the course of a year:

	Eight-Hour Days
Electric clothes-washing machine	19½
Electric vacuum cleaner	19½
Electric dishwashing machine	13
Electric iron	6½
Electric ironing machine	13
Electric sewing machine	3½
Electric toaster	3½
Electric percolator	3½
Electric fan	3½
Total	84½

In this calculation, which was prepared by the Rochester (N. Y.) Gas & Electric Corporation, the saving merits of the devices are set forth in terms of days, but it is pointed out that there is no way of estimating the additional saving of physical effort accomplished through the liberal use of electric service.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Synchronized Induction Motors.—LE MONNIER.—The Compagnie Générale Électrique in Nancy is building a large type of industion motor, rated at 300 hp. and 750 r.p.m., which may be run synchronously in Danielson connection. For this purpose the motor is equipped with a direct-current exciter put on the same shaft as the main rotor. The machine is started as an ordinary induction motor, but when it has reached full speed it may be pulled in step by switching on the direct-current excitation in the rotor winding. The rotor therefore has a coil winding and slip rings, and the exciter is a special low-voltage, high-current machine. The synchronized induction motor is built as an ordinary slip-ring motor, except for certain details of design. For instance, since the power factor after synchronization is adjustable by varying the excitation it is not necessary to give the motor a very small air gap. Consequently open slots may be used, permitting the adoption of machine-made rotor and stator coils. The efficiency of the machine when running as a synchronous motor with unity power factor is about 92 per cent, exciter included. —*Revue Générale de l'Électricité*, Nov. 13, 1920.

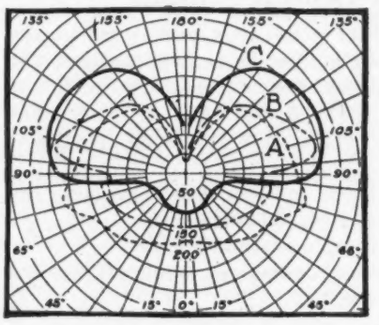
Mechanical Construction of Waterwheel-Driven Alternators.—E. MATTMAN.—The mechanical problems involved in building alternators for waterwheel connections are shown by the fact that in case the load is suddenly disconnected and the governor fails to act promptly excessive speeds of the generating unit develop. The author maintains that overspeeds of approximately 85 per cent must be anticipated in the case of reaction-type turbines. For impulse wheels the generator is designed for overspeeds up to 100 per cent.—*Electric Journal*, January, 1921.

Lamps and Lighting

Lighting of Armories and Gymnasiums.—A. L. POWELL and A. B. ODAY.—Owing to the great height of ceilings, which fixes the elevation of the lamps well above the ordinary angle of vision, high-power gas-filled lamps may be used to advantage in, and with suitable reflectors have become standard for, large drill halls. In modern practice the actual power consumption for armories with wooden floors has varied from 0.25 watt to 0.55 watt per square foot (2.5 watts to 5.5 watts per sq.m.). It is said that with fairly efficient reflecting equipment the coefficient of utilization should be somewhere between 40 and 50 per cent. Actual tests at two armories investigated showed 2.5 foot-candles of illuminations which was quite uniform. The author also discusses maintenance of fixtures and the lighting of miscellaneous rooms in the armory.—*Bulletin L. D. 116, Edison Lamp Works*, Harrison, N. J.

Survey of Voltage Conditions in Automobile Lighting. —H. H. MAGDSICK and HOWARD KARG.—This article states that results obtained with headlighting equipment differ from those anticipated largely because of these five factors: (1) Variation in individual bulbs; (2) variation in individual sockets, including adjustment with reference to the focal point and alignment; (3) variation in individual reflectors as regards finish of surface and contour; (4) variation in cover glasses in respect to directing and proportioning the light; (5) variation in lighting systems as regards voltage impressed at the lamp. The greatest factor in producing variation of the illumination from a given type of headlighting equipment, the authors say, is the range of voltage impressed at the lamps, and the results of an investigation into the magnitude of this variable and an analysis of some of the contributing elements are reviewed.—*Transactions I. E. S.*, November, 1920.

The Bowl-Enameled Lamp.—WARD HARRISON.—This comparatively new lamp was developed to provide a high-powered light source for industrial plants which would be free from the objectionable glare common to various types of unshaded lamps. The enameling on the lower half of the bowl effects almost complete diffusion of the transmitted light, it is said, and when the lamp is used with a suitable steel reflector the resulting illumination is noticeably free from glare and sharp shadows. The enamel forms a smooth surface which does not collect dirt and is also said to withstand the action of water, acid fumes and ordinary mechanical abrasion incident to shipping and handling.—*General Electric Review*, December, 1920.



COMPARATIVE CANDLEPOWER DISTRIBUTION CURVES FOR GAS-FILLED LAMPS: (A) CLEAR, (B) BOWL-FROSTED, (C) BOWL-ENAMELED

Generation, Transmission and Distribution

Economic Study of Secondary Distribution.—P. O. REYNEAU and HOWARD P. SEELYE.—The purpose of the paper is said to be to study from an economic viewpoint the conditions generally met with in secondary distribution and to furnish as far as possible guidance for the designer to aid him in any particular problem with which he has to deal. No definite rules can be established which will fit all conditions on account of the many variations in the problem. The general problem is to determine the proper combination of wire, transformer and transformer spacing in order to give good conditions of operation, and also to show the least cost per year for the load densities expected during the period of time under consideration. Curves and tables are presented facilitating the calculations suggested by the authors.—*Journal A. I. E. E.*, October, 1920.

Operating Performance of Insulators on a 45,000-Volt System.—H. B. VINCENT.—A description of a form used

for collecting data pertaining to the condition of pin-type high-tension insulators removed from service, with an analysis of the data obtained from such a report showing the performance of insulators on various lines from 1914 to 1919 inclusive. The percentage of injured and damaged insulators to the total number installed and the percentage of cases of damage of each particular nature to the total failures are given.—*Journal A. I. E. E.*, January, 1921.

Cockerill Blast-Furnace Gas Boilers.—It is said that in order to increase the efficiency of a common gas-engine installation an attempt has been made to utilize a great proportion of the waste heat contained in the exhaust gases which had heretofore been allowed to exhaust straight into the atmosphere. The increased efficiency of gas-engine installations equipped with exhaust-gas boilers is discussed.—London *Engineer*, Nov. 19, 1920.

On the Design of Insulator Pins.—DONATH.—An article dealing with the mechanical design of insulator pins. Formulas are derived which show what dimensions the pin should have in order to afford the necessary strength with minimum weight of material.—*Elektrotechnische Zeitschrift*, Oct. 14, 1920.

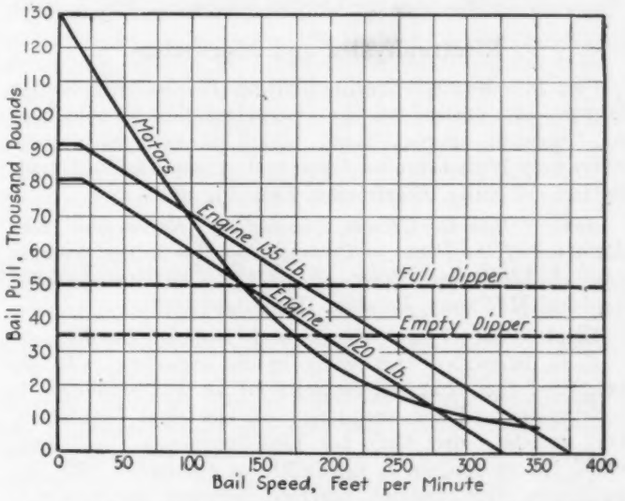
Superpower Transmission.—TRÖGER.—The author questions whether the common three-phase system is the best way of transmitting power over great distances and suggests that a considerable saving of copper would result from combining two star-connected three-phase systems into one four-wire system by connecting two star points so that the voltages in the interconnected legs will be in phase, the common point of the two stars being grounded. He then proceeds to deal from an economical point of view with the question of high-tension three-phase power transmission, with particular regard to the proposed system of 100,000-volt cross-country lines in Germany. It is said to be a general rule that the most economical amount of energy transmitted over one line increases in the same proportion as does the consumption per square mile in the district served by the line. At present from 100,000,000 kw.-hr. to 200,000,000 kw.-hr. is transmitted per line each year over existing lines in Germany, but the future energy transmission per line probably will rise to four times as much as the consumption density increases, and the maximum load on a double line will probably be from 100,000 kw. to 150,000 kw., so that each line must be capable of transmitting from 50,000 kw. to 75,000 kw. On the basis of pre-war prices the author finds that the most economical voltage for transmitting this amount of power 200 km. to 600 km. is about 200,000. A deviation of 20,000 volts from this value, however, will increase the total cost of transmission by only 1 per cent. But a transmission voltage of 100,000 the author considers to be insufficient for Germany's future needs.—*Elektrotechnische Zeitschrift*, Nov. 18, 1920.

Traction

Corrosion Due to Ground Currents.—ZANGGER.—A rather comprehensive article containing a report of the work of a Swiss commission appointed for the purpose of investigating the effects of electrolytic corrosion caused by ground-return currents of direct-current electric railways. The work of the commission supplements some recent investigations made at the Bureau of Standards in Washington. The author describes various methods used in determining the rail currents and the currents in underground pipe lines running along the track. By means of a bridge method measurements were made to determine resistance of several types of rail bonds, and it was found that in general the rail connections used in Switzerland have too high a resistance, so that the corrosion often may be considerably reduced by improving the conductivity of the rail bonds. Methods for computing the ground current distribution are also outlined in the paper and applied to practical cases, the results being checked against the results of actual tests.—*Bulletin Schweizerischer Elektrotrotechnicher Verein*, October and November, 1920.

Installations, Systems and Appliances

The Electric Shovel in Open-Cut Mining.—C. R. FISHER and H. G. HEAD.—Coal deposits with overburden too shallow to permit shaft mining now constitute the most profitable form of coal mining when large electrically driven stripper shovels are used. The principal contributing factors, the authors assert, are the greater depth of cut which the larger shovel can make, the increased bulk of material which its greater radius of action permits it to remove before consuming time to



CHARACTERISTICS OF SERIES MOTORS COMPARED TO THOSE OF A STEAM ENGINE

make a forward movement, and the lower labor and power costs. The performance of the large electric shovel in stripping operations has led to its adoption in other branches of mining, and this article describes the construction and operation of the latest type 300-ton electric shovel as applied to open-cut limestone quarrying, where it has every promise of duplicating its success in coal mining, according to the authors. Curves show that with heavy loads the dipper speed is higher for electric drive and the stalling pull is much greater.—*General Electric Review*, December, 1920.

Analytical Determination of Steps in the Starter of a Series Motor.—STANLEY PARKER SMITH.—In this paper a simple analytical method for calculating the resistance steps in the starter of a series motor is given, and examples are worked out illustrating the application of the method to the series motor and to two series motors arranged for series-parallel control. The solution of the problem entails a knowledge of the magnetization curve, or of the speed curve, of the motor, but no graphical construction is necessary for obtaining the results.—*Journal Institution of Electrical Engineers*, London, August, 1920.

The Liquid Slip Regulator.—GUY F. SCOTT.—A discussion of the liquid slip regulator, which is used in connection with induction motors equipped with flywheels in order to make use of the flywheel energy when sudden loads are thrown on the motors. The use of the flywheel energy is brought about by increasing the slip of the induction motor either by the use of a permanent resistance or by introducing resistance at the proper time by means of automatic slip regulators.—*Electric Journal*, January, 1921.

Oil Switches for Large Electrical Supply Systems.—It is said that the chief problems relating to the control of systems fed from stations with capacities between 100,000 kva. and 200,000 kva. may be summarized as follows: (1) Means must be found to insure maintenance of voltage at all parts of the system and prevent disturbance of running machinery. (2) Arrangements must be made to limit the power which can be concentrated at any point on a fault occurring and to a figure not calling for excessive expenditure in the construction of individual pieces of apparatus. Short-circuit characteristics of alternators and speed of oil-switch openings with units of extremely large size are discussed in this paper.—London *Engineer*, Sept. 3, 1920.

Electrophysics and Magnetism

"K. S." Magnet Steel.—KOTARO HONDA and SHOZO SAITO.—An outline of the characteristics of this type of tungsten magnet steel, which is said to possess extremely high coercive force and strong residual magnetism.—London *Electrician*, Dec. 17, 1920.

Some Optical Effects, Including Refraction and Rotation of the Plane of Polarization Due to the Scattering of Light by Electrons.—J. J. THOMSON.—*Philosophical Magazine*, London, December, 1920.

Electrostatic Transformers and Coupling Coefficients.—F. C. BLAKE.—Starting from the experimentally determined fact that the capacity of an air condenser is independent of the frequency of electrical oscillation, this article shows that for high-frequency conditions, when the resistance is negligible as compared with the reactance, the capacity reaction between the two circuits can be expressed best in terms of elastances. Definitions are given for self and mutual elastances as well as for self and mutual capacitances, and the definitions are tested by knowledge of spherical condensers. The true relationship between Maxwell's coefficients of capacity and the elastances of capacitances is pointed out in the case of the spherical condenser. The ideas developed are applied to the thermionic tube, and thereby the behavior of the ultraudion and the experiments of Van der Pol are readily explained. Attention is called to the alternative view of the behavior of condensers toward alternating currents, namely, that instead of being paths of low impedance they are paths of ready yielding or low stiffness or elastance, as suggested by Heaviside and by Karapetoff.—*Journal A. I. E. E.*, January, 1921.

Units, Measurements and Instruments

Errors in Energy Measurements Due to Phase Errors in the Instrument Transformers Used.—GOLDSTEIN.—There are four different ways of connecting current and potential transformers for energy measurements by kilowatt-hour meters in a three-phase system. The small phase deviations between primary and secondary in the instrument transformers may cause considerable errors in the reading of the kilowatt-hour meter. The author shows how the resulting errors may be computed for the four possible cases when the phase deviations of the transformers are known. By means of his formulas it is easy to determine in any given case what combination of transformers will give the smallest error and how big that error is.—*Bulletin Schweizerischer Elektrotechnischer Verein*, November, 1920.

Telegraphy, Telephony and Signals

German Radio Research.—In a brief report on research in progress at the German Telegraphen-Versuchsamt is included a description of an interesting arrangement for recording radio telegraphic signals. The reception is based upon the beat method. In order to obtain audio selectivity an intermediate resonance circuit, tuned to the beat frequency, is interposed between the detector tube and the three-stage audio amplifier used. From this amplifier the impulses pass on to a special high-power amplifier, consisting of two four-electrode vacuum tubes with extra steep characteristics (audions with double grid). These two tubes are coupled by a transformer with a winding ratio of 15,000 to 60,000. The second tube also acts as a rectifier and translates the audio signals into direct-current dots and dashes. In the plate circuit of the last tube is inserted a 10,000-ohm relay, which in its turn controls a Wheatstone printer. Only four batteries are needed for this equipment, one on 6 volts and one on 12 volts for filament heating currents and two batteries on 90 volts for supplying the plate circuits.—*Elektrotechnische Zeitschrift*, Nov. 4, 1920.

Recent Inventions in Wireless Telephony.—A description of the provision of side-tone and intercommunication on wireless telephone sets for aircraft.—*Wireless World*, Oct. 16, 1920.

Miscellaneous

Guiding Ships by Submerged Cables.—LOTH.—In the summer of 1919 experiments were made on a large scale at Brest with the method of guiding ships through fog by means of a single-pole cable carrying an alternating current of audible frequency. This system was referred to in these columns some time ago. During the Brest experiments the cable current was about 2.5 amp., and the ships were provided with four 3-ft. by 8-ft. (0.9-m. by 2.4-m.) coils with sixty turns each and with different orientation in the ship. The coils were directly connected to telephone receivers, and the author states that the sound could be distinctly heard more than a mile from the cable, so that the cable could be easily picked up and followed by the ship. The same guiding method has been tried with very good results for dirigibles and hydroplanes. Airships provided with suitable search coils may thus be safely navigated even in dense fogs or darkness by aid of a guiding cable, which naturally in such a case does not have to be submerged in water.—*Comptes Rendus*, Oct. 11, 1920.

Foundations for Machinery.—N. W. AKIMOFF.—Considerable contradiction arises from blindly applying the principles of the building foundation to the design of substructures for machinery, and this sometimes results in the necessity for the use of cushions or of adding other yielding adjuncts to the foundation. The writer presents a theory which includes the effect of vibrations which arise from lack of balance or from other causes. —Paper presented at the annual meeting of A. S. M. E., Dec. 7, 1920.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Electrical Contractors to Study Installation Costs

PLANS to study installation costs, to further the study on overhead costs and to revise wiring standard symbols were discussed at the annual meeting in New York this week of the executive committee of the National Association of Electrical Contractor-Dealers. James R. Strong of New York was elected national chairman and Thomas M. Templeton of Detroit, B. H. Bendheim of Chicago and James R. Strong committeemen at large. The following were appointed to the labor committee which forms the National Labor Council: L. K. Comstock, New York; A. J. Hixson, Boston; Robley S. Stearnes, New Orleans; K. A. McIntyre, Toronto, and G. M. Sanborn, Indianapolis.

The executive committee discussed and gave the association its sanction to assist in a plan for a revision, in conjunction with engineering and architectural bodies, of the standard symbols for wiring plans.

A subcommittee was appointed to work out a standard system of keeping costs on the installation of electrical materials. The object is to secure reliable cost data that can be compared, along the same lines as the standard cost accounting system for merchandising.

Authorization was given Secretary Morton to go ahead with the collection of overhead costs. He was instructed to send a questionnaire on this subject to the entire membership.

California Commission Welcomes Legislative Investigation

RESPONDING to the attacks made upon it by some members of the State Legislature who are supporting a movement for a legislative investigation of its actions, the California Railroad Commission has issued a statement declaring:

"The Railroad Commission cheerfully and gladly welcomes any honest, fair and impartial investigation of its decisions and acts. It assumes that an inquiry made by a committee under direction of the State Legislature will be an earnest, sincere and thorough-going attempt to ascertain all the facts upon which to base an intelligent report dealing with the subject of the regulation of public utilities, the principles which govern the fixing of rates, the manner of their application and the extent of the benefits which the people dependent upon such service derive therefrom."

In the course of a brief review of the whole industrial and utility situation the commission says:

"Public utility rate increases have been held far below the level of all other commodity prices. Practically every other article which enters into the life of our people has advanced in price to a far greater extent than utility service. The Railroad Commission has seen to it that the public utilities of California were not permitted to make an unjust or an unfair profit."

New York's Governor Against Municipal Operation

WHILE recommending the unification and ultimate municipal ownership of the electric transportation systems of New York City as the only solution to the traction problems there, Governor Miller in his message to the New York Legislature this week condemned municipal operation. "I think," he said, "municipal operation of the lines would be fatal. The railways should be run on an efficient, businesslike basis, and the public never runs its affairs that way."

The Governor of New York has recommended that all utilities of the state, except the New York traction companies be placed under the regulation of one public service commission at Albany. The metropolitan traction companies he would regulate by a separate commission in New York City. At present there are two commissions, the up-state commission regulating all utilities except those operating in New York City which are under a separate commission.

Power Commission Refuses Consideration to Prospective Use of Niagara Water

WHILE the ruling on the part of the Federal Power Commission that it would not consider applications or entertain discussion covering the prospective use of water under an amended treaty with Great Britain lessened interest in the hearings by the commission on Jan. 24, 25 and 26, each session was an animated one and was well attended by those interested directly and indirectly in water-power development.

Several of the applicant companies had filed applications for preliminary permits involving the prospective use of water under an amended treaty. While the commission ruled against hearing these applications, it was made clear that this was not to preclude its consideration of possibilities arising from additional diversions in considering the proposals for the use of existing water. Nothing developed at the hearing to indicate in the slightest degree that the commission will disturb the rights now exercised by the Niagara Falls Power Company.

The Niagara Falls Power Company urged the approval by the Federal Power Commission of the plan which has been approved by the army engineers and by the Secretary of War. A supplemental plan provided for over-all development from Echota to Lewiston. The power company stated that it was ready to accept a license and proceed with such development. The Niagara Power & Development Company's representatives started to discuss the utilization of 10,500 second-feet of the diversion now being used by the Niagara Falls Power Company. It was evident, however, that the commission was not in sympathy with such a proposal. This, together with the recent refusal of the city of Buffalo to

back the plan, doubtless was the cause of the development company's waiving its application to that effect. The Niagara Falls Power Company appeared to support its application for the full 19,500 second-feet, the entire diversion now authorized, except for the 500 second-feet which goes through the Erie Canal. The company proposed either to use the entire amount of the diversion at the falls or to use one-half of it at the existing plant at the falls, taking the remainder over the top development. The opinion was expressed that the more feasible scheme would be to use the entire amount of the diversion at the falls. That would require the construction of a pressure tunnel which would carry the additional 10,000 ft. down to the power house adjacent to the company's new plant and would mean the eventual abandonment of the old plant above the falls, although it would be kept in stand-by condition.

Development in the gorge is proposed by the Lower Niagara River Power & Water Supply Company. The company is affiliated with the Niagara, Lockport & Ontario Power Company. The same scheme is proposed by the Niagara Gorge Power Company, which is owned by the Gorge Railroad Company. It was brought out that the gorge development must go before the International Joint Commission.

Representatives of the State of New York appeared at the hearing and requested and received permission to file a brief subsequently.

A. L. Sweat of the Western-New York Utilities Company urged a larger diversion of water through the barge canal.

APPLICANTS NOT TO OPPOSE DECISION

In regard to utilization of any additional diversion, the commission was advised by the Niagara Power & Development Company and the Niagara, Lockport & Ontario Power Company that the companies are in agreement that the grant to the successful applicant will not be opposed by the other company. The unsuccessful applicant will surrender to the other company the right-of-way it may possess.

Morris Cohen, Jr., counsel for the Niagara Falls Power Company, told an interesting story of the pioneering work which has been done by his client since the first hydraulic canal was built in 1853. He stated that the Buffalo General Electric Company has the largest single-firm power contract with the company he represents or 57,500 hp.

John W. Van Allen, representative of the Buffalo Chamber of Commerce, told the commission that the distribution of power should not be left to a private concern. He said it should be directed by a utilities commission. His attention was called to the fact that the water-power act vests the Federal Power Commission with authority in the event that the state does not create such a commission. He admitted that the present rates are very reasonable. He urged that a ten-year limit be placed on a license if one were granted to the Niagara Falls Company. He urged that the commission approve development in the lower gorge and questioned the probability of the revision of the treaty. Mr. Van Allen also objected to the allocation of additional power to electrochemical and electrometallurgical companies at Niagara Falls.

A Senate amendment to the sundry civil bill will authorize the Federal Power Commission to employ expert personnel for the carrying out of some of the technical phases of its work.

Western Inspectors Discuss Transformer Hazards and Grounding Secondaries

A LIVELY discussion of the merits of oil-filled apparatus was started at the meeting of the Western Association of Electrical Inspectors in Detroit on Tuesday by the declaration that oil-cooled transformers are considered a hazard by insurance companies. Hubert J. Clark, engineer of the Oklahoma Inspection Bureau, who made this statement, also said that oil-filled transformers should be removed from building interiors. While fires caused by such apparatus are seldom heard of, there is little chance that material modifications will be made in the present code requirements.

W. L. Granger of the Detroit Edison Company outlined the policy of that company in making installations and took issue with Mr. Clark's saying that he believes that the opinion expressed was based on experience with early apparatus that was not up to the present standards. Mr. Granger made a strong plea for the installation of transformers out of doors so far as possible, because the ventilation and handling of transformers indoors are so difficult. In the opinion of Mr. Granger automatic devices used in connection with the ventilation of transformers installed indoors operate so seldom that they are never in condition when they are really needed. It was agreed during the discussion of the paper that burning oil should be drained to a sump rather than to the sewer.

GROUNDING OF SECONDARIES

F. A. Barron, General Electric Company, reviewed the history of grounding secondaries, in which the early investigations and patents of Elihu Thompson covering the subject were described. Following this paper W. J. Canada compared the safety and fire-code provision for grounding secondaries. There was considerable difference of opinion as to the grounding of circuits where voltages are in excess of 150 volts to ground. Furthermore, the opinion was expressed that grounding two-wire direct-current circuits needs further consideration.

Speaking on the responsibility of the contractor, E. McCleary said that when the work is under the supervision of an engineer or architect his responsibility is limited to the following of the specifications. Where he is wholly responsible for the design and installation of the work, his responsibility for the grounding is still limited if there is any doubt as to what constitutes proper grounding. The contractor should be held only for thoroughly established practices.

The subject of safeguarding electric fixtures brought some very positive statements from Charles H. Hofrichter, for the National Council of Lighting Fixture Manufacturers, and J. L. Wolf, for the Lighting Fixture Dealers' Association, as to the steps being taken to improve the product of this branch of the industry. The two associations through these two men gave a very frank statement of the situation and indicated that steps are being taken that will result in standardization of both the mechanical and electrical features of fixtures.

Vice-President St. John of the Detroit Electric Furnace Company gave a talk on the application of the electrical furnace, which was illustrated by motion pictures.

A theater party Tuesday evening, with the annual banquet Wednesday evening and a stag and smoker on Thursday evening, were the social features of the meeting. Friday was devoted to inspection tours.

Big Daylight-Saving Meeting Planned

AS PART of the efforts to obtain action in the present Congress on daylight saving for the Eastern time zone the commercial organizations of the cities of New York, Boston, Philadelphia, Pittsburgh and Baltimore and the State of New Jersey have called a meeting in New York on Feb. 9. Invitations have been sent to commercial and trade organizations in all the New England States and in New York, New Jersey, Pennsylvania, Delaware, Maryland, Ohio, West Virginia, North Carolina, South Carolina, Georgia and Florida, which compose the Eastern time zone, to send representatives to this meeting. A bill, introduced by Senator Walter E. Edge and Representative E. R. Ackerman of New Jersey, providing for daylight saving in the Eastern time zone for five months, from the last Sunday in April to the last Sunday in September, is pending in Congress.

Daylight-Saving Bills in Congress

A NUMBER of daylight-saving bills are pending before the interstate commerce committees of the United States Senate and House of Representatives. No action is probable in either committee, however. The House committee reported favorably the bill to repeal daylight saving last year and is certain not to reverse itself at this time, and the Senate committee, it is authoritatively said, is equally unlikely to sponsor any of the bills. All of them will die March 4.

New England Electrical League Formed at Boston

SIX HUNDRED representatives of all branches of industry attended a meeting and banquet at Boston on Wednesday evening to celebrate the formation of the New England Electrical League for the development of business and advancement of mutual interest through co-operative service. The speakers were Martin Insull, president National Electric Light Association; Henry C. Attwill, chairman Massachusetts Department of Public Utilities; Bowen Tufts, president New England Geographic Division, N. E. L. A.; C. S. Beardsley, William L. Goodwin, Frank S. Price and Dr. Perry Bush. Guy W. Cox was toastmaster. Mr. Insull also addressed an assemblage of 250 at luncheon, emphasizing the importance of publicity in developing central-station industry and credit to meet further service demands.

Move to Abolish Home Rule in Michigan

DECLARING that "most people now believe that it is good public policy to demand that utilities furnish a reasonably efficient service, and they also believe that it is equally good public policy that public utilities receive an adequate rate for such service," Representatives Defoe of Alpena, Mich., announced a few days ago the preparation of a bill to give the State of Michigan full control of its public utilities. He also declared that "a state utility commission, possessing and exercising complete control over all utilities, with broad powers of regulation, can pass upon the equity or inequity of any rate free from any local bias or prejudice and can keep the rates throughout the state on an equal basis and without any discrimination." Mr. Defoe pointed out the inability of the municipalities outside of Detroit to engage in the investigations required if rates fixed by the local authorities are to stand in court. The long dispute between the city of Detroit and its street railway was cited as an evidence of the need for the proposed legislation.

Society for Electrical Development Attacks Fire Underwriters' Figures

THE National Board of Fire Underwriters has recently published figures covering 1915 to 1919 inclusive which place the fire losses for the five years at $1,416,375,000. The compilation, it is stated, covers the adjustment of 3,500,000 insurance claims, to which 25 per cent was added as a conservative estimate of unrecorded burnings. The most frequent cause of fires is said to be electricity, which is charged with losses totaling $84,086,471—almost 6 per cent of the total reported fire loss.

The Society for Electrical Development has conducted a thorough investigation into the causes of all fires—not simply those for which insurance claims were made—and has on file reports of fire chiefs, department heads, central stations and state officials from 345 towns and cities of more than 5,000 population with an aggregate population of 28,495,851 in 1919, or a very large proportion of the country at that time supplied with electric service. The total number of fires recorded is 138,553, of which number only 3,568 in residences and commercial buildings could be in any way traced to electrical origin. That is, only 2.57 per cent of all fires were traceable to the use of electricity, and a very large proportion of these were due to gross carelessness.

The figures compiled by the society not only rank electricity as a comparatively small fire hazard but show that only about one-third as many fires are started by electricity as are caused by the careless use of matches and the reckless throwing about of cigar and cigarette stumps.

As there is no reason to believe that a fire having its origin in an electrical defect is necessarily more disastrous than one started in some other way, such compilations as that of the National Board of Fire Underwriters are, in the opinion of the society, valueless.

Commission Formed to Secure Action on Colorado River Development

THE Colorado River Commission was permanently organized at Salt Lake City, Utah, on Jan. 21, with the expressed aim of securing concerted action by Utah, Colorado, Nevada, Arizona, Wyoming, California and New Mexico and the federal government in the development of the power and irrigation possibilities of the river and its tributaries. There was tentatively adopted by the commission for presentation to the legislatures of the states involved and to Congress a bill calling for the permanent appointment by each state of a representative on the commission. Frank E. Weymouth, chief engineer of the Government Reclamation Service, was selected as secretary of the organization, and the members pledged themselves to supply him with all available data concerning projects on the Colorado River and its tributaries. This information will be made the basis for concerted action to be determined upon at future meetings of the commission.

Pacific Coast Section, N. E. L. A., Convention, May 25-27

THE annual convention of the Pacific Coast Section of the N. E. L. A. will be held at the Hotel Del Monte, Del Monte, Cal., on May 25, 26 and 27. Partial programs for the divisional meeting have been prepared. The technical committee will present the following papers: "Power Necessities and Resources of California," by P. M. Downing; "Factors Affecting Fixing of Rates Based on Power Factor," by J. P. Jollyman; "Relay Problems in Large Interconnected Systems," by E. R. Stauffacher; "Progress in the Development of 220,000-Volt Transmission," by J. A. Koontz; "Operating Difficulties from the Viewpoint of Load Dispatchers," by F. R. George. The commercial committee will present the following papers: "The Electric Range and Water Heating," "The Convenience Outlet," "Illumination," "Industrial Heating," and "Meeting the Demand for Retail Salespeople."

Prominent Engineers to Discuss New York City Power Development

AS A PART of its program to take up problems having to do with the logical and orderly development of the community that surrounds the waters of New York harbor the New York Section of the American Society of Civil Engineers will hold a joint meeting with the other founder societies at the Engineering Societies Building in New York on Wednesday evening, Feb. 9, at which time Col. William Barclay Parsons will speak on "Light, Heat and Power." A discussion of the engineering problems of this kind that face the metropolitan district in connection with its future development will be participated in by J. W. Lieb, vice-president New York Edison Company, New York; Frank Smith, vice-president United Electric Light & Power Company, New York; Farley Osgood, vice-president Public Service Electric Company, Newark, N. J.; George Otis Smith, U. S. Geological Survey, Washington, D. C.; H. E. Skougor, consulting engineer, New York; George Gibbs, consulting engineer Gibbs & Hill, New York; William Cullen Morris, engineer of construction Consolidated Gas Company, and F. O. Blackwell, consulting engineer Viele, Blackwell & Buck, New York.

United States Chamber of Commerce Adopts Street-Railway Program

BY A VOTE of 1,657 to 24 the organizations making up the membership of the Chamber of Commerce of the United States have declared for the continued private ownership and operation of street railways. The question was one of eight submitted to a general referendum of its members by the Chamber of Commerce and embodying recommendations made by its committee on public utilities. The result of the referendum has just been announced and showed substantial unanimity for all the recommendations, of which the remaining seven were to the following effect: That existing traction facilities should be conserved; that the attitude now taken toward street-railway problems should be based on the present and future needs of the community; that regulation should everywhere be instituted that will follow promptly changes in the situation of the companies rendering services of local transportation; that provision should be made against the consequences of unfair competition; that all burdens unrelated to the service performed should be removed from street railways; that official responsibility should be definitely fixed for the application of regulation, and that each company should seek to have available for the public at all times the facts as to the results of operation and should have resident responsible executives wholly conversant with local requirements.

The referendum on public utilities is the thirty-third taken by the chamber. Lewis E. Pierson of the Irving National Bank, New York, is chairman of the public utilities committee.

Possibilities in Waterwheel Design and Accurate Measurement of Flow

SOME radically new ideas on developing water power and measuring water flow through long penstocks were presented at the hydro-electric symposium held at Philadelphia on Friday of last week. For a local meeting this symposium was conspicuous in attracting engineers of national reputation from coast to coast and representing three national engineering societies—the A. I. E. E., the A. S. M. E. and the A. S. C. E. The meeting, which was held under the auspices of the Engineers' Club of Philadelphia, very nearly filled the auditorium of the Manufacturers' Club, about 300 being present.

As an indication of the simplicity and high specific speed which may be expected in waterwheels in the near future Lewis F. Moody, consulting engineer I. P. Morris department of the William Cramp & Sons Ship & Engine Building Company, referred to a new type of wheel which his company has developed and is investigating that looks very much like a marine propeller.

This new conception of a waterwheel has been made feasible from a commercial standpoint by the recent achievements in converting whirl velocity in the draft tube into pressure head. Since 1907, when the highest specific speeds were between 200 and 300 r.p.m., the speeds have increased to from 500 to 600 r.p.m. With such high specific speeds and very high heads the wheels must be placed very close to tailwater level, or even below this elevation in some cases. This would be possible, Mr. Moody explained, by inverting the turbines and allowing the water to discharge upward against a regainer. Wicket gates could then be dispensed with by placing a conical-topped hydraulic plunger below the wheel in such a manner that raising it would reduce the water inlet area.

The new method of measuring water flow explained by Norman R. Gisbon, hydraulic engineer Niagara Falls Power Company, enables taking readings at each gate opening with only two minutes' shutdown for each. Furthermore, extremely high accuracy can be obtained, the mean error compared with volumetric measurements made at Cornell University being + 0.2 per cent. In general this method of measurement depends on the change in hydraulic pressure accompanying a change in velocity.

Interesting addresses were also made by F. H. Rogers, hydraulic engineer of I. P. Morris department, Cramp company; R. D. Johnson, consulting engineer; John L. Harper, vice-president and chief engineer Niagara Falls Power Company, and David B. Rushmore, chief engineer power and mining department, General Electric Company.

Important requirements of water turbines demanded in hydro-electric development were discussed by Mr. Rogers, particular attention being given to high speed, high efficiency, high power, reliability and durability.

Mr. Johnson emphasized the advantages of using surge tanks, calling particular attention to the merits of the differential type.

Mr. Harper dwelt on the possibilities of developing 6,000,000 hp. at Niagara Falls without marring its beauty and called attention to the benefits which are being derived from the existing development. Some attractive motion pictures were displayed.

The paper by Mr. Rushmore dealt with general features of hydro-electric power production and problems involved in the transmission, distribution and utilization of the energy generated.

Great Falls Hearing Scheduled for Feb. 1

A PUBLIC hearing in connection with the Great Falls water-power project on the Potomac River will be held Feb. 1. The hearing was to have been held earlier, but owing to an unavoidable delay in the completion of the report, it was impossible to discuss the details of the plan which the Corps of Engineers' U. S. A., has worked out. It is expected that the report will be passed upon by the chief of engineers prior to the hearing so that those not in agreement may have an opportunity to present their objections.

Worst Effects from Business Depression Are Over, A. W. Douglas Thinks

ALTHOUGH the general business situation has changed little during the last few months, there are pronounced indications that the first shock of the present depression is over, in the opinion of Archer Wall Douglas, chairman of the committee on statistics and standards of the Chamber of Commerce of the United States, as expressed in his monthly report on business conditions, just issued.

"The most cheering and hopeful feature of the situation is the fast-spreading realization that what we are going through is the only possible way to teach us the indispensable need of hard, conscientious work, some thought of obligation to our tasks, and getting back once more to those temporarily lost arts of salesmanship, of common-sense merchandising, of economical, efficient production and distribution," Mr. Douglas says. "Automatically everywhere production is adjusting itself to demand. This phase has finally reached the iron and steel industry and is general throughout industrial life. Automatically the situation is tending to a more normal relation between supply and demand, which means the solution of many of our problems. The fundamental soundness of the situation is widely felt. The general mental attitude, while recognizing the completeness of the collapse of inflation, perceives that it was not only inevitable but necessary.

"There is much surface, but often superficial, optimism as to the near future. A good deal of it is obviously intended for public consumption. Some of it, too, would be more convincing if it did not come from those who live in a financial atmosphere and have scant personal knowledge of actual conditions prevailing in that vast stretch of country beyond the ken of those in the great congested centers. That so many, living in the scenes of stagnant trade and low prices for farm commodities, still have reasonable confidence in the future is the best assurance we have in the belief, in meteorological phrase, that the center of the depression is now passing over us."

Good-Will Advertising Program Gets Under Way

THIS week the co-operative advertising campaign under the auspices of the National Electric Light Association to promote good-will building for the electric light and power industry will get under way in the popular magazines. The campaign has been under way in the electrical press for some weeks. The association's own advertising campaign will begin Feb. 19 with a half-page advertisement in the *Saturday Evening Post*. Twelve similar advertisements will appear in subsequent issues.

The first of the manufacturers' advertising in popular magazines will appear Jan. 29 in *Collier's Weekly*, and during the months of February and March other good-will advertisements will appear in such magazines as the *Literary Digest*, *Collier's Weekly*, the *Saturday Evening Post* and the *American Magazine*, over the name of the company donating the space, as follows: General Electric Company, Schenectady, N. Y.; Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.; Wagner Electric Manufacturing Company, St. Louis; Western Electric Company, New York City, and Mazda Research Laboratories, Cleveland. The Robbins & Myers Company will publish quater-page central-station good-will advertisements during March in Chicago, Detroit, St. Louis, New York, Cleveland, Philadelphia, Boston, Fresno, Santa Rosa, Sacramento and Cincinnati newspapers.

The following companies also have agreed to use space in national popular magazines: Hoover Suction Sweeper Company, New York City; Edison Electric Appliance Company, New York City; Habirshaw Electric Cable Company, New York City; Duplexalite Company, New York City, and Hurley Machine Company, Chicago.

The following additional companies have agreed to use space in the trade papers: Trumbull Electric Manufacturing Company, Plainville, Conn.; Hygrade Lamp Company, Salem, Mass.; Condit Electrical Manufacturing Company, South Boston, Mass.; Kuhlman Electric Company, Bay City, Mich.; Burke Electric Company, Erie, Pa.; Electric Storage Battery Company, Philadelphia; Majestic Electric Development Company, Philadelphia; Locomotive Electric Washing Machine Company, Belleville, Ill.; *Elcetrical Review*, Chicago; Federal Electric Company, Chicago; Sangamo Electric Company, Springfield, Ill.; Moloney Electric Company, St. Louis; Roller-Smith Company, New York City; Power Specialty Company, New York City; Westinghouse Lamp Company, New York City; Packard Electric Company, Warren, Ohio; Canadian Westinghouse Company, Ltd., Hamilton, Ontario; Hamilton-Beach Manufacturing Company, Racine, Wis.; Syracuse Washing Machine Corporation, Syracuse, N. Y.; Comas Cigarette Machine Corporation, Salem, Va.; Britton & Doyle, Cleveland; Jeffrey-Dewitt Insulator Company, Huntington, West Va.; P. A. Geier Company, Cleveland; Anaconda Copper Mining Company, Chicago; Domestic Electric Company, Cleveland, and ELECTRICAL WORLD, New York City.

New England Electrical Development Committee Formed

TO FORMULATE a commercial expansion plan for 1921 through co-operation by all branches of the electrical industry in New England, an electrical development committee has been organized at Boston. William Gould of the Gas & Electric Improvement Company, Boston, has been named as chairman. This committee is the outgrowth of much recent work along the line of bringing the different branches of the industry into co-operative relations, and its work is to include the correlation of activities and interests of the different branches and unification of activities designed to popularize the development of electrical service and the use of electrical apparatus and merchandise. The following representatives of the various branches of the industry compose the committee: Manufacturers—C. B. Burleigh, S. B. Condit, F. J. Allen, W. S. Davis, D. C. Gidley, G. H. Cox; central stations—William Gould, V. M. F. Tallman, F. H. Smith, R. E. Holden, R. D. Cutler, J. E. Gray; jobbers—W. F. Abely, J. E. Livor, Almon Foster, F. S. Hardy, H. M. Savage, George H. Wahn; contractor-dealers—George B. Quinby, J. E. Wilson, J. P. Coghlin, H. W. Porter, Harry Cole and A. J. Hixon.

Calder Coal-Control Bill Is Securing Consideration

WHILE there is virtually no chance for any legislation at this session of Congress providing for federal regulation of the coal industry, the passage of the packers' bill and the hearings before the Senate committee on manufactures have had the effect of bringing about serious consideration of the Calder bill. This measure provides a rather drastic form of coal control in times of emergency, authorizes price fixing and the licensing of all those engaged in the trade. A permanent feature would be the compulsory filing of costs and profits and other statistical data, which would be made public in a way that would permit the consumer to analyze his coal costs.

Dr. George Otis Smith, director of the United States Geological Survey, told the committee on manufactures that the coal business could no longer be considered a private one. He expressed the opinion that it should be placed in the same category with the public utilities.

At the request of the committee, George W. Elliott, secretary of the National Committee on Gas and Electric Service, appeared and spoke to the following effect:

"The public utilities have suffered tremendously for the past year in their coal supply, principally through the flagrant disregard of contract obligations on the part of the coal operators. The public utilities consume annually 50,000,000 tons of coal. Much of this tonnage is contracted for yearly in advance. Great hardships were placed upon the public utilities, particularly during the period when a runaway market existed. Coal that should have been furnished to public utilities in compliance with the contract obligations apparently was diverted to the spot market, where prices could be obtained far in excess of those stipulated in the various contracts.

"There was a period during the emergency when the utilities were not receiving 50 per cent of the coal for which they had contracted. They were of necessity compelled to go into the open market and pay the outrageous prices that were being asked by the coal operators for export coal. The alternatives would have been either to curtail their output or to close their plants."

Mr. Elliott was not asked his opinion as to whether the Calder bill would remedy the situation and vouchsafed no opinion. It was made clear to the committee by him that the National Committee on Gas and Electric Service had held aloof from all matters concerning prices. Its activities in Washington had been confined generally to securing and expediting shipments of coal that already had been contracted for.

O. P. Hood, the chief mechanical engineer of the United States Bureau of Mines, declared that quality control of coal is just as important as is control of price and distribution.

Last Obstacle to Southeastern Interconnection Removed

THE approval of a writ of convenience issued by the Alabama Public Service Commission giving permission to the Alabama Power Company to construct a high-tension transmission line from Gadsden, Ala., to the Georgia state line removes the last legal obstacle in the way of the construction of a tie line between the Alabama Power Company and the Georgia Railway & Power Company. The Georgia Railway & Power Company will construct a line from its Lindale switching frame, connecting with the line built by the Alabama Power Company's line when completed, and will provide for the interchange of energy between these two large corporations. This is the last link necessary to provide for the interchange of energy between all the large power companies in the Southeast.

The line, which will be designed for 110,000-volt operation, will be of pole-type construction and will make use of aluminum conductors of No. 2/0 equivalent. It is expected that the line will be in operation about June 1, 1921.

Storage Development Recommended in New Hampshire Report

WATER conservation through storage development is recommended in the 1919-20 report of George B. Leighton, commissioner on water power and water conservation, to the New Hampshire Legislature, which was briefly referred to in the ELECTRICAL WORLD of Jan. 22, p. 224.

In the report submitted two years ago the main object was to place in concise form knowledge as to the possibilities for the conservation of water, so that better control of stream flow could be secured and more stable power-plant operation gained. The present report brings to hand the latest data on the power developments and possibilities of the state, which have been rendered doubly important by fuel prices.

"It is hardly possible or desirable," says the report, "that the state should in any wise obligate itself or pledge its credit toward the installation of water power, but in the matter of conservation the commissioner distinctly recommends that the state take some definite step toward assisting in this matter." The expenditure of, say, two million dollars, after proper engineering examination on the headwaters of the Connecticut and

Merrimac Rivers, would be warranted economically, the report declares.

The total developed horsepower in New Hampshire, as listed with the co-operation of the Water Resources Branch of the United States Geological Survey, C. H. Pierce district engineer, is 217,007 hp. in waterwheels. Auxiliary steam power totals 82,540 hp. On the Merrimac River and its tributaries in New Hampshire are 87,553 hp. in waterwheels, and on the Connecticut and its tributaries within the state 70,875 hp. The Androscoggin River in New Hampshire has 41,200 hp. in waterwheels, and the coastal streams in the state account for 17,379 hp. Mr. Pierce's report, which is embodied in the main report, points out numerous opportunities for the development of additional head. These include 1,974 ft. on the Connecticut and tributaries within the state, the total developed head now used being 2,554 ft. On the Merrimac and tributaries, 2,402 ft. additional head is available, with a present development of 3,932 ft., and on the Androscoggin important redevelopment work is already in progress in the Berlin-Gorham district. It is estimated that the development of seventeen sites in the Connecticut River basin would yield 390,000,000 hp.-hr. a year and that twenty-one sites on the Merrimac basin would yield 152,000,000 hp.-hr. Betterment work and interconnection are suggested as means of obtaining much larger output from existing and future installations.

National Electrical Code Submitted to Engineering Standards Committee

THE National Fire Protection Association has submitted the 1920 National Electrical Code to the American Engineering Standards Committee for approval as an "American standard." This code is submitted in accordance with the special provision in the procedure of the committee under which important codes in existence prior to 1920 may be approved without going through the regular process followed in new work. The committee is now making an effort to learn of the extent to which the code is used and any other information regarding the code in meeting the needs of the industry.

No New Development Work Planned by Idaho Power at Present Time

AN APPLICATION has been made by the Idaho Power Company for a preliminary permit under the water-power act to develop 66,000 hp. at the Upper Salmon Falls of the Snake River for public utility purposes, and another to develop 25,000 hp. at Twin Falls, on the same river, for similar purposes. It is stated by officials of the company that it is planning to develop under its filing with the Federal Power Commission 20,000 hp. at Upper Salmon Falls and 8,000 hp. at Twin Falls. The filings were made as required by law and for the purpose of supplying supplemental power to the territory that is held by the company in southern Idaho.

At present, owing to the financial situation, it is not planned to do any new development work or to extend the company's territory, but when the financial situation clears, and within the time limit allowed under the federal law, the necessary installations to carry the supplemental power will, it is stated, take place.

California Commission Bars Out "Good Will" as Element in Valuation

IN A DECISION fixing the price to be paid by the city of Redding for the electric distributing system of the Northern California Power Company in that city the California Railroad Commission a week or two ago made a far-reaching declaration against according any value to "good will" as an element in arriving at a fair price. "The element of good will, as the term is applied to a business in a public utility," it declared, "is not to be considered in estimating the value of a public utility plant, for the reason, among others, that the public utility enjoys a monopoly of a particular business in the community it serves and the public has no choice but to buy from the public utility or do without such service."

That profits made by the utility through rates fixed by the commission cannot be capitalized by the utility as a measure of value was another declaration made by the commission. This declaration was in answer to the company's claim that because of the profits made out of its business in Redding the property had a value of $83,000 over and above the value of the physical property, which amounted to about $50,000. The commission granted that the company is entitled to be reimbursed for reasonable development cost unless it can definitely be demonstrated that this cost of developing the business has been made up in later excess earnings.

Another important rule laid down by the commission was that the general operating condition and efficiency of a plant must receive consideration in the finding of its value. Establishing a "basis of just compensation to be followed in similar proceedings in the future, the commission also fixed the methods of valuation of the plant and of finding the depreciation in the property, these to prevail unless it can definitely be shown that the rules are not applicable in other cases."

In the matter of franchises, for which the company put in a special claim, the commission allowed the amount actually expended. The company also made a large claim for severance damage on the ground that the city of Redding should pay for the loss of business. The commission rejected the company's contention and allowed severance damages only covering the cost of changes in the physical plant. Including severance damage allowed by the commission, the total amount involved in the proceeding is relatively small, the sum to be paid by the city of Redding being fixed at $49,800. The minimum amount claimed by the company for the same property and as severance damage was in excess of $200,000.

The company claimed that the Fourteenth Amendment of the United States Constitution had been violated because Redding had adopted the commission's engineers' valuation and offered no valuation of its own. This contention the commission overruled. Further importance is lent to the case by the fact that it deals with purchase as distinguished from rates and that this is the first decision of the commission in which it unanimously sets up general guideposts to be followed in the future.

Concerned with the Northern California Power Company, Consolidated, in the proceedings was the Pacific Gas & Electric Company, which has purchased the property of the Northern company.

Baltimore Utilities Arrange for Interchange of Service

THE Consolidated Gas, Electric Light & Power Company, the United Railways & Electric Company and the Pennsylvania Water & Power Company of Baltimore have entered into an agreement covering the sale of the electric generating station on Pratt Street, owned by the two last-noted companies, to the Consolidated company and the purchase of power from the latter by the railway company. The agreement provides for a payment of $4,000,000 for the power station and for increased power supply by the Pennsylvania company to the Consolidated company, as required. The railway company in the future will devote its time exclusively to traction operations. Under a perpetual contract, with flexible terms adjusted to changing conditions, it will purchase all electrical energy needed for the operation of its lines from the Consolidated company.

The power station has been operated solely as an emergency plant heretofore, the main source of supply having been the Susquehanna River plants of the Pennsylvania company. The United company has arranged for a note issue of $1,500,000 in connection with the agreement, and the Consolidated company will make a first payment of $1,250,000 on the plant as soon as the contract has been approved by the Public Service Commission, to which it has just been presented.

Contract Closed for Extension of Salt Lake's "White Way"

THE contract between the city of Salt Lake and the Utah Power & Light Company, covering the installation and maintenance of a new lighting system on State Street from South Temple to Fourth South, on Broadway from West Temple to Second East, and on Fourth South from Main to State Street, has been finally executed.

There will be fourteen standards to the block, seven on each side of the street, with three lamps on each standard. The arc lamps to be used will be of approximately 2,000 cp. each and will be exactly similar to the lamps now in use on Main Street. The distribution of light will be so worked out that all parts of the street will be lighted to virtually the same intensity.

The new district will comprise 112 standards and 336 arc lamps, while the total, including Main Street, will be 182 standards and 546 lamps. The new installation represents an investment on the part of the property owners and of the city of approximately $100,000.

Right to Make Connection Charge Taken to Supreme Court of New Jersey

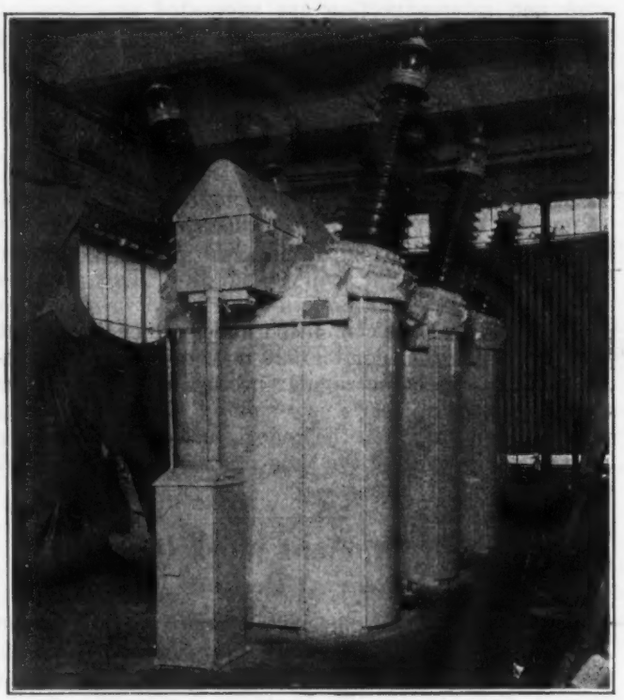
FOLLOWING the refusal of the New Jersey Board of Public Utility Commissioners to allow a connection charge, the Public Service Electric Company has carried the case to the Supreme Court and has obtained a writ of certiorari to review the order of the board, dated Nov. 23.

The Public Service company holds that the order is without warrant in law, that it is not reasonably supported by the proofs taken before the commission, and that it violates the constitutional rights of the corporation, taking for public use its property without due compensation. Further, the assertion is made that the order denies the company equal benefits of the law. In its contention the company points out that in the introduction of its business and in its desire to obtain customers it made connections for service without charge.

Later on, by reason of increased cost and expenses for labor and material and increased demand for additional and more expensive service, the capital outlay of the corporation grew unduly burdensome and it became necessary to reduce it. Accordingly, on Aug. 12 last a schedule of rates was adopted providing under certain circumstances for the payment by a consumer of the cost of wires and conductors upon his private property.

These rates, it is held, were entirely reasonable and conformed to charges made by other companies for similar service. This schedule of rates was refused by the Board of Public Utility Commissioners.

Record-Size Circuit Breaker for Great Western Power Completed



WHAT is, so far as can be learned, the largest oil circuit breaker in kva. rating ever manufactured is shown in the accompanying photograph. This machine has just been finished by the General Electric Company for the Great Western Power Company of California. It is one of seven machines of the same size which are being built for that company.

The breaker is built for operation at 165,000 volts and 400 amp. at any altitude from sea level to 4,000 ft. It is solenoid operated, the solenoid being actuated through a relay energized by a bushing transformer. It is closed by means of a pull switch placed wherever convenient. The contacts, explosion chambers and so forth conform to the standard design for this type of breaker. The total length of the three units is 32 ft., and the height measured from the bottom of the tank to the top of the insulators is 16 ft. The complete apparatus weighs approximately 25 tons and requires more than 4,000 gal. of oil.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

A Copper-Aluminum Alloy.—A new alloy of copper and aluminum has been invented and tested by the Aktiebolaget Skandinaviska Armaturfabriken. The name given to the new combination is "alcobronze," and it is said to be harder, tougher and stronger than any other bronze and to resist the action of the air, acids and salt water.

Jerusalem Talks of Water Power.—Hydro-electric development is claiming its own in the most ancient as well as the most modern lands. At a recent meeting in Jerusalem of the advisory council of the Zionist organization concerned with the setting up of the new Palestine it was unanimously agreed that in fixing the boundaries of the state not only water supply for irrigation but the inclusion of sources of hydro-electricity must be assured.

Water-Power Development in New York State.—The proceeds of new bond and stock issues amounting to more than $2,500,000 are to be used by the Northern Utilities, Inc., of Watertown, N. Y., for the construction of a hydro-electric plant at Flat Rock, on the Oswegatchie River, at an estimated cost of $730,182, and for extensions to the existing electric development of the company at Brown's Falls, on the Oswegatchie, in St. Lawrence County, at an estimated cost of $1,782,726.

Great Northern Hydro-Electric Plant to Double Output.—A fuel-oil plant will, it is announced, be constructed at once at the Chelan River hydro-electric development by the Great Northern Power Company which will enable that company to double the present output from this point. The new plant is to furnish the additional electrical energy needed during the two years required to build at a cost of $1,500,000 the great generating plant designed to furnish energy for the contemplated electrification of the Great Northern lines.

Electricity Figures in Far-Reaching Scheme of Development for South Louisiana.—A comprehensive scheme of development in south Louisiana by means of gravity canals is described by a correspondent of the *Manufacturers' Record*, who says that the plan, which has been advocated for years by Welman Bradford, a Louisiana engineer, would involve the expenditure of $28,000,000 and that its inauguration is now waiting only on the passage of a resolution by Congress declaring Bayou Cocodrie a non-navigable stream. This bayou will form part of the system, which would drain waste lands and irrigate a great area of rice fields. The plans include the construction of hydro-electric plants along the canal route. Four sites have been selected, from which, according to the promoter, enough energy to furnish light and power to every city and town in south Louisiana, including New Orleans, could be obtained. It is also planned to build a trolley line along the entire canal route to furnish power to electrically propelled barges. Modern highways are another contemplated feature. The system, as designed, will be in the shape of a giant fan, with the handle starting from Red River above Natchitoches and spreading out radially.

A Medical Treatment for Electric Shock.—In contrast with the prone-pressure method of resuscitation from electric shock and the vigorous physical handling of the victim which has been found an efficient aid in restoring consciousness is the pharmaceutical treatment recommended, according to an English contemporary, by Dr. D'Halluin, presumably a European physician of note, who finds that an electric current kills in two ways—by paralyzing the respiratory center in the medulla and by causing the heart to fibrillate and then to stop. Dr. D'Halluin has found injections of a 5 per cent solution of potassium chloride into the jugular vein very efficacious for stopping fibrillation of the heart. He believes in artificial respiration, but says that "rhythmical tongue traction" may cause cardiac and respiratory inhibition. If the heart is beating, he says, artificial respiration and motion of the limbs are the best method, and he announces as the result of experiments that even where the heart had stopped heart massage was effective in 22 per cent of the cases. Failure ensues if fibrillation has taken place.

Research Graduate Assistantships.—To assist in the conduct of engineering research and to extend and strengthen the field of its graduate work in engineering, the University of Illinois, Urbana, Ill., maintains fourteen research graduate assistantships in the engineering experiment station. These assistantships, for each of which there is an annual stipend of $600 and freedom from all fees except the matriculation and diploma fees, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics or applied chemistry. An appointment to the position of research graduate assistant is made and must be accepted for two consecutive collegiate years, at the expiration of which period, if all requirements have been met, the degree of master of science will be conferred. Not more than half of the time of a research graduate assistant is required in connection with the work to which he is assigned. This year there will be thirteen vacancies, and applications for appointment should be sent to C. R. Richards, director, not later than March 1.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Pittsburgh Section, American Electrochemical Society.—Colin G. Fink, manager of the laboratories of the Chile Exploration Company, New York, was announced to address this section last night, Jan. 28, on "Modern Developments in Metallurgical Research."

Joint Engineering Meeting at Boston.—The third and last of the series of joint meetings at Boston of the electrical, mechanical and civil engineers to discuss water-power problems will be held on Tuesday, Feb. 8, under the auspices of the Boston Section of the American Society of Mechanical Engineers. The speaker will be W. M. White, chief engineer hydraulic department Allis-Chalmers Maufacturing Company, on the topic "Recent Waterwheel Developments and Settings."

St. Louis Electrical Board of Trade.—A new method in the arrangement of a program for the coming year has been announced by the general entertainment committee of the St. Louis Electrical Board of Trade. Instead of making up the complete program for the year itself, the general committee has designated a number of sub-committees to handle the work, each committe representing a certain branch of the industry. Thus the manufacturers sub-committee will follow up the subject of standardization, the utilities sub-committee will arrange for talks on questions involving public utilities, and the other sub-committees will arrange programs dealing with their particular problems. Sub-committees were appointed to represent manufacturers, utilities, jobbers, dealer-contractors, engineers and manufacturers' agents. The general committee will conduct occasional meetings to be devoted to subjects of immediate interest and value to the industry as a whole.

Coming Meetings of Electrical and Other Technical Societies

Institute of Radio Engineers — New York, Feb. 2.

Association of Iron and Steel Electrical Engineers—Philadelphia Section, Feb. 5; Cleveland Section, Feb. 14.

Florida Engineering Society — Lakeland, Fla., Feb. 7 and 8.

American Institute of Electrical Engineers —Portland (Ore.) Section, Feb. 7; Chicago Section, Feb. 28.

A. I. E. E., A. S. M. E. and A. S. C. E. (joint meeting)—Boston, Feb. 8.

New Mexico Electrical Association—Albuquerque, Feb. 14 and 15.

American Institute of Mining and Metallurgical Engineers — New York, Feb. 14-17.

A. I. E. E. — Midwinter convention, New York, Feb. 16-18. (For program see issue of Jan. 8, page 111.)

American Physical Society — New York, Feb. 25 and 26.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Eighteen Months' Operation at Loss Sufficient to Entitle Company to Relief.—In passing upon exceptions taken to the report of the special master in Kings County [Gas] Lighting Company vs. Nixon, the United States District Court for the Southern District of New York has asserted that even if a period of eighteen months when conditions were abnormal was insufficient experience on which to fix a reasonable rate, it is sufficient to show that the existing rate was confiscatory where the plant was operated at a loss during the entire period. (268 Fed. 143.)*

Responsibility for Injury from Guy Wire Alongside Public Road.—In Tanner vs. Athens Electric Light & Power Company, a suit brought for damages because of injuries received by a horseman driving cattle along a public road who came into contact with a guy wire of the company said to be in immediate proximity to the road, the Court of Civil Appeals of Texas found that if the wire was so situated that the company might have foreseen by the exercise of reasonable care that injury might result therefrom unless the wire were shielded, the company was negligent. The horseman was not confined to the traveled part of the road, which had no sidewalks, and the distance of the guy wire from the road which would free the company from responsibility and also the question of the company's negligence were for the jury. (225 S. W. 421.)

Order of Public Service Commission on Its Own Motion Void and Open to Collateral Attack.—According to a decision of the New York Supreme Court, Appellate Division, in People vs. Monarch the Public Service Commissions law of New York, although authorizing investigations and inquiries by the commission on its own motion, does not authorize the making of any order, and an order directing a railway company to collect only a single fare between certain points was without jurisdiction and might be attacked collaterally in a prosecution for ejecting a passenger refusing to pay an additional fare. The commission's jurisdiction over the public utilities coming under its regulatory powers, the court holds, applies only when the question is one of reasonableness of fares and service, and not when the question is one of law as to the fares chargeable by a carrier under its franchise. (185 N. Y. S. 5.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Cause of Fright of Horse Ascribed to Electric Shock Question for Jury.—Ordering a new trial in Monfort vs. Indianapolis & Cincinnati Traction Company, where the trial judge had directed a verdict for the defendant, the Supreme Court of Indiana declared that the questions of negligence and of the cause of the fright of a horse alleged to be due to electricity escaping from a rail at a highway crossing on the company's interurban railway were matters for submission to the jury. (128 N. E. 842.)

"Casual" Employee May Not Recover Under Nebraska Workmen's Compensation Act.—In finding for an industrial company sued by a workman injured in unloading coal (Bridges vs. Lincoln Feed & Fuel Company), the Supreme Court of Nebraska pointed out that by the terms of the workmen's compensation act of that state its benefits did not extend to "casual" workmen, the word being defined in the act to mean "occasional, coming at certain times without regularity, in distinction from stated or regular." A laborer not steadily employed but engaged by the job and who worked at intervals for other companies as well as for the defendant was a "casual" employee. (179 N. W. 1020.)

State Versus Federal Control Where Nature of Action Is Equitable.—From the decision of the Supreme Court of North Carolina sustaining the lower court in the issuance of a mandamus to compel the Southern Power Company to continue to furnish electricity to the North Carolina Public Service Company at Greensboro and High Point (see ELECTRICAL WORLD, Dec. 25, page 1282) a dissenting opinion was filed by two judges which contains an exhaustive discussion of jurisdiction in such suits as between the state and the federal courts. This dissenting opinion, favoring the transfer of the case to a United States court, says: "The real nature of the action is equitable—*i.e.*, one for a mandatory injunction instead of a proceeding for a writ of mandamus, as the distinction is recognized at common law, in the light of which distinction the terms of the acts of Congress conferring jurisdiction on the federal courts must be construed. Then, even conceding that the state court might, under the code of practice prevailing in the state, award the plaintiff the relief sought in this action in a proceeding which the state court would permit to be brought and described as a proceeding for a writ of mandamus, the federal court cannot, upon this ground or for this reason, be deprived of its jurisdiction of the action if jurisdiction in fact exists under the acts of Congress. . . . Mandamus will not lie unless there has been an actual default on the part of the defendant, nor will it ever be granted in anticipation of an omission of duty. This proposition of law is based upon a fundamental distinction between law and equity jurisprudence and is universally recognized and applied." (104 S. E. 872.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Conditions Governing Permission of Competition in Inadequately Served Territory.—In granting a certificate of convenience and necessity to an electric company to operate in a city already but inadequately served by another company the Missouri Public Service Commission made it a condition that the applicant should file a written offer with the commission to purchase the electric plant of the existing company at a price to be fixed by the commission.

Powers of North Dakota Commission.—The sale of an electric plant and property in North Dakota without an order from the Board of Railroad Commissioners is void, according to a recent decision of the board, and the vendors are guilty of violating the law. When a milling company, which is inherently private in character, desires to enter the field of furnishing a public service it then in so far as the public service is concerned comes within the jurisdiction of the board.

Valuation Practice of North Dakota Commission.—The fair present value of the actual physical property used and useful in producing utility service, and not the amount of the investment, is the basis upon which the North Dakota Board of Railroad Commissioners calculates rate of return. In valuing the property of an electric company the commission made an allowance of 12 per cent for overhead expenses, including engineering, superintendence, interest during construction, taxes during construction, fire and liability insurance, small omissions of inventory, contingencies and so forth. It excluded from consideration the value of a service extension no part of the cost of which had been paid by the utility.

Loose Accounting Methods Condemned.—In passing upon an application from the Cottage Grove Electric Company for increased rates, the Public Service Commission of Oregon condemned emphatically the incompleteness of the data and records furnished by the company and charged that the utility had been "grossly negligent and delinquent in its duty in the making out and filing of its annual reports to this commission and in its accounting system," declaring that the record was insufficient to warrant the commission in making an order fixing rates for lighting and power. It found, however, as the result of its valuation proceedings, that the value of the plant for rate-making purposes is $68,067, and this valuation has been adopted as a basis for rate making.

Men of the Industry

Changes in Personnel, Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

J. P. Jollyman has been promoted to the position of chief of the division of hydro-electric and transmission engineering of the Pacific Gas & Electric Company from that of engineer of electrical construction. He will have charge of all the engineering work relating to hydro-electric stations, substations and communication and transmission lines. Mr. Jollyman was born in California, Oct. 29, 1879, and after graduation from Stanford University in 1903 was employed by the California Gas & Electric Corporation as electrician. From 1909 to 1911 he was employed by the Great Western Power Company of California first as superintendent of the Big Bend station, being then promoted to the position of electrical engineer. He returned to the Pacific Gas & Electric Company as engineer of electrical construction. Mr. Jollyman has designed some of the most notable of the hydro-electric stations of the Pacific Gas & Electric Company and is considered to be one of the leading electrical engineers on the Pacific Coast. He has been a frequent contributor to the technical press and has taken a large part in the affairs of electrical associations and societies. At present he is chairman of the San Francisco Section of the American Institute of Electrical Engineers.

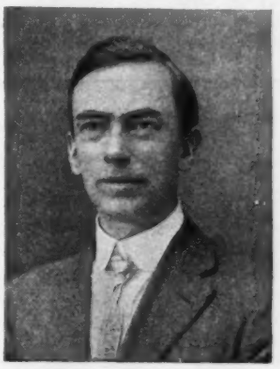
J. P. JOLLYMAN

H. C. Deffenbaugh, who left the Empire State Gas and Electric Association ten months ago to take up important work in connection with a survey of the water-power possibilities of New York State under the direction of Col. William Barclay Parsons, has returned to the association to take up his duties as engineer and assistant to the secretary. Part of Mr. Deffenbaugh's duties will be to assist gas and electric companies of New York State in relation to cost analyses, preparation of rates and schedules.

John Hunter, who was chief engineer of the Union Electric Light & Power Company, St. Louis, from 1905 to 1917, will return to St. Louis about Feb. 1 to become chief engineer of the Heine Safety Boiler Company. Mr. Hunter is well known in engineering circles in St. Louis, having had charge of designing, constructing and operating all of the generating stations of the Union Electric Company. He was closely associated with Hugh L. Cooper, of the Mississippi River Power Company, in building the hydro-electric plant of that company at Keokuk, Iowa. Mr. Hunter's earlier years were spent at sea as an engineer officer, and during the Spanish-American War he was chief engineer of the St. Paul under Captain Sigsbee. After the war he served as chief engineer officer on the same vessel until he went to St. Louis in 1905. In 1917 he was called East by the government to assist in shipbuilding and was first detailed as government representative in charge of the Submarine Boat Company and afterward transferred to the Standard Shipbuilding Corporation at Shooter's Island, New York. While in charge there he has built twenty-five cargo vessels, two mine sweepers and two passenger vessels, and four oil tankers under his supervision are nearing completion.

JOHN HUNTER

Frank Conrad, consulting engineer of the Westinghouse Electric & Manufacturing Company, who has been appointed assistant chief engineer, has been connected with that company for almost thirty years. One of the most important early developments in which he was engaged was the design of alternating-current measuring instruments. Here his shop experience on construction of the Shallenberger ampere-hour meters and his experience with arc-lamp mechanisms served him well. About this time the early work of Shallenberger on induction instruments was in progress. A feeding mechanism requirement for an alternating-current arc lamp suggested to Mr. Conrad the idea of using an "induction-type" or eddy-current-operated disk for an arc-lamp feed. This led directly to the original conception of the disk-type induction-indicating alternating-current voltmeters and ammeters and the original "round-type" Westinghouse watt-hour meter, which he designed and brought out in 1897. During the war Mr. Conrad devoted much time to the development of radio apparatus for the Navy and War Departments. The airplane radio apparatus which he developed was extensively used in France.



FRANK CONRAD

P. B. Sawyer, vice-president of the Lehigh Power Securities Corporation, which controls the Lehigh Valley Transit Company, has been elected president of the Lehigh Valley Transit Company, Allentown, Pa., to succeed Harrison R. Fehr. Mr. Sawyer has been a vice-president and director of the Lehigh Valley Transit Company and its subsidiaries for three years. He will continue to reside in New York.

Dr. W. R. Whitney, director of the research laboratory of the General Electric Company, Schenectady, N. Y., was awarded the Perkin medal on Jan. 14 by the American Section of the Society of Chemical Industry. This medal was given in recognition of the many inventions through which Dr. Whitney has applied chemistry to the service of mankind.

Robert E. Horton, Harry Barker and Robert C. Wheeler have become associated, under the firm name of Horton, Barker & Wheeler, to continue the consulting engineering practices formerly carried on under the names of Robert E. Horton, consulting hydraulic engineer, Albany, N. Y., and Harry Barker and Robert C. Wheeler, engineers, New York City. The new firm will have its headquarters in Albany, with offices in New York and Harrisburg, Pa., and an engineering laboratory at Voorheesville, N. Y. It will specialize in power development and transmission, water supply, sewerage and sewage disposal, public utility rates and valuation.

T. H. Bibber has severed his connection with the Duplex Lighting Works of the General Electric Company to become sales engineer for the Triangle Conduit Company, Inc., Brooklyn, N. Y.,

T. H. BIBBER

in charge of the merchandising of the wiring specialties made by that company.

Harry W. Osgood has been appointed plant engineer of the Fore River works of the Bethlehem (Pa.) Shipbuilding Corporation, Ltd., at Quincy, Mass., in accordance with the establishment of a policy of decentralizing the engineering of the various plants of the company. Mr. Osgood was formerly electrical engineer of the company, with headquarters at Bethlehem. He was graduated in the electrical engineering course from the Worcester (Mass.) Polytechnic Institute in 1905 and for about a year was employed by the J. G. White Engineering Corporation, New York. He then joined the engineering staff of Stone & Webster, with headquarters at Boston, and remained there until September, 1917, when he was appointed electrical engineer of the American International Shipbuilding Corporation, with headquarters at Hog Island shipyard, having charge of the electrical work at this establishment. In the fall of 1919 Mr. Osgood became connected with the Bethlehem company.

C. H. Minor, general manager of the China Electric Company, one of the Western Electric's foreign subsidiaries, has been decorated by the President of the Republic of China with the Chia-ke (Excellent Crop) decoration of the fourth class. The award was issued by Kuo Isu-Yun, chief of the bureau of appointments. It was given in recognition of the assistance which the China Electric Company has been able to render to the government of the Chinese Republic.

P. T. Carey, engineer of the China Electric Company, who was presented with an honorary medal by the Chinese government last spring for his co-operation with the bureau of communications of the republic, has been further honored by being appointed honorary technical adviser to the Chinese government's electrical testing bureau. The testing bureau is in its infancy, but it has prepared elaborate plans for the future.

Daniel M. Luehrs has established the Daniel M. Luehrs Company, with offices and laboratories at Cleveland, Ohio. A specialty will be made of industrial engineering in all its phases. The company's laboratories will be in charge of C. A. Breed, a metallurgist formerly with the General Electric Company. H. W. Hough, formerly chief electrical engineer of the Cleveland Electric Illuminating Company, will have charge of the company's electrical work.

J. H. Libbey, until recently electrical engineer Eastern Massachusetts Street Railway, has joined the organization of H. M. Haven & Wm. W. Crosby, engineers and architects, with offices at 40 Court Street, Boston. Mr. Libbey is widely known in electrical circles in New England. He was graduated in mechanical engineering in 1898 from the Lawrence Scientific School of Harvard University, and for a time was employed by the Bethlehem Steel Company, Bethlehem, Pa., in connection with high-speed tool-steel development work under F. W. Taylor. For four years he was in the engineering organization of Westinghouse, Church, Kerr & Company at New York and Boston, and his early work included power-plant development and construction on the Boston & Northern Street Railway. During the period of design and construction of the electrified zone of the New York, New Haven & Hartford Railroad Mr. Libbey was assistant electrical engineer under W. S. Murray, and he resigned from this post to join the engineering organization of Stone & Webster at Boston. He continued with this firm for seven years, his work embracing a variety of engineering problems, including central-station and power-plant work, transmission and appraisals. For the last seven years he has been electrical engineer for the Bay State, now the Eastern Massachusetts, system. He had entire charge of the power supply on that property following the resignation of C. F. Bancroft.

H. J. Moyer, who has represented the Yarnall-Waring Company, maker of power-plant devices, and the Nelson Valve Company in the Chicago territory for several years, has severed his connection with the Nelson Valve Company and will represent the Yarnall-Waring Company exclusively in that territory as district manager.

H. L. Ball has been appointed sales manager of the Requa Electrical Supply Company, Rochester, N. Y. For the last three years Mr. Ball has been sales manager of the Rochester (N. Y.) Electric Supply Company. Previous to that he was with the Westinghouse Electric & Manufacturing Company in a sales and engineering capacity.

B. S. Manuel, heretofore manager of the appliance section of the supply department of the Westinghouse Electric & Manufacturing Company at Mansfield, Ohio, has resigned to become gen-

B. S. MANUEL

eral manager of the Electric Railway & Manufacturers' Supply Company, electrical jobber in San Francisco.

David Moore, commercial agent of the El Paso (Tex.) Electric Company, has been transferred to Galveston, Tex., as manager of the sales department of the Galveston Electric Company.

Hugh A. Brown has been appointed sales manager of the Electro Dynamic Company, Bayonne, N. J., and will have charge of the marketing of its motors and generators. Mr. Brown has had an extended experience in sales work, having been connected with the Crocker-Wheeler Company and the Burke Electric Company in the marketing of their products.

J. L. McQuarrie, assistant chief engineer of the laboratories of the Western Electric Company at 463 West Street, New York City, who has just returned from the Orient, was decorated by the Emperor of Japan before he sailed. He also received the order of the Rising Sun, fifth class, in recognition of his services in the telephone engineering field and the aid he has rendered in the development of Japanese transmission progress.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Leniency in Collections May Have Its Advantages

ALTHOUGH the bottom has apparently dropped out of things and sales for the most part are being made from accumulated stocks, American business and industry are solvent. True, failures are on the increase—have been so as a matter of fact ever since the beginning of 1920—still they are by no means commensurate with the depressed condition of business. Business, in other words, is better able to absorb a loss than ever before.

Still, that is no indication that the surplus in the safe is limitless. It is probably true that, except for the inevitable few, the business of the country is strong enough to weather a period of dullness. There is some doubt, however, that industry can continue to keep its head above water and still pay all its debts promptly.

Failures are increasing. According to Dun's they were $30,000,000 in the first quarter of 1920, $57,000,000 in the second quarter, $80,000,000 in the third quarter, and $129,000,000 in the last quarter. During the month of January the reports have indicated that there is no lessening of the upward trend.

This was to be expected, but the curve can be greatly flattened, business strengthened, money made easier and new business stimulated if only the large producers will not be too pressing at this time in their demands for settlement.

Standardization of Washing-Machine Motors

IT IS utterly impossible for all washing-machine motors made by different manufacturers to have uniform physical characteristics even for the same horsepower ratings, but about 60 per cent of the delays in getting out any specific shipment of washing-machine motors could be eliminated if the shaft extension were adopted of a standard size, length and flat.

This conclusion was arrived at by a committee of the American Washing Machine Manufacturers' Association working in conjunction with a committee from the Electric Power Club. The recommended dimensions of the standard shaft extension are ½-in. diameter, 1.5-in. length and a flat running the entire length of the extension. The committee of the Power Club also recommends that any motor manufacturers contemplating a change in design should get in touch through the American Washing Machine Manufacturers' Association committee with the Power Club committee, which will gladly advise with them to the end that eventually standard motors may be produced.

However, the standard base contemplated for the largest and smallest quarter-horsepower washing-machine motors proved impracticable for mechanical reasons. It also had the additional objection that in order to accommodate the largest motor the shaft height would have to be 3¼ in., which would mean that about 85 per cent of the motor manufacturers would have to change the method of their motor mounting.

Comparative British and United States Exports for Nine Months

AN interesting comparison is given in the accompanying table made up from figures published by *Beama* giving exports of electrical materials from the United Kingdom during the first nine months of 1920 and from returns of the Bureau of Foreign and Domestic Commerce giving the nine months' figures on exports from the United States of electrical articles similar to those exported by the United Kingdom and to the same countries.

The exports from the United Kingdom are given in dollars, based on the equivalent of $3.50 for each pound sterling.

One of the outstanding features in British trade appears in the exports to India. This country has taken more batteries, generators, motors, switchboards and control than any of the other countries listed, and the countries listed are those which provide the most important outlets for electrical goods. India was second in meters and measuring instruments and third in receipt of static transformers.

It would be expected that Canada would use the United States as a market rather than Great Britain. Australian figures show her receipts from the States to be bigger than from Great Britain, and New Zealand the same, while British South Africa apparently is about evenly divided in its patronage. The European countries, Belgium, France, Spain, Italy and Norway, are buying more from the United States than they are buying from their nearer manufacturer, it seems.

COMPARATIVE EXPORTS OF ELECTRICAL APPARATUS FROM THE UNITED STATES AND GREAT BRITAIN FOR FIRST NINE MONTHS OF 1920

	Batteries		Dynamos and Generators		Meters and Measuring Instruments		Motors		Transformers (Static)		Rheostats, Controllers, Switches, Accessories,	Switchboards and Control
	U. S.	Gt. Britain	U. S.	Gt. Britain	U. S.	Gt. Britain	U. S.	Gt. Britain	U. S.	Gt. Britain	U. S.	Great Britain
Br. So. Africa	$197,591	$80,800	$35,798	$66,700	$27,009	$70,000	$175,518	$129,400	$20,811	$18,600	$42,450	$25,600
Argentina	296,881	46,500	42,862	15,800	47,117	25,800	182,431	39,400	88,317	5,150	24,728	45,200
Australia	228,213	81,400	68,398	66,200	54 853	83,000	435,563	271,000	143,944	51,000	176,844	59,750
Belgium	13,245	17,000	50,590	48,700	23,689	44,008	455,170	173,000	592,617	92,800	48,018	16,900
Brazil	138,636	34,000	112,387	38,500	84,587	29,000	282,958	28,200	140,314	15,500	370,928	7,620
Canada	1,486,175	10,950	415,630	14,600	483,577	12,900	1,776,098	27,000	822,308	.....	94,961	3,600
Chile	41,511	2,640	40,028	8,780	14,177	11,300	89,480	26,950	22,087	.....	56,816	2,240
China	82,217	15,540	633,565	30,200	113,417	71,600	402,242	55,200	154,646	.....	207,044	41,800
France	108,188	7,630	546,397	33,300	43,360	53,500	486,650	163,800	72,852	11,050	27,670	14,500
Hongkong	17,564	35,000	93,079	4,180	11,343	19,800	29,587	147,000	41,602	4,280	14,761	7,950
British India	189,413	318,000	352,302	205,000	14,685	156,400	398,966	686,000	98,693	32,800	270,913	242,000
Italy	4,586	5,920	180,426	12,640	79,134	170,000	302,582	95,000	48,126	.....	26,056	8,100
Japan	129,143	8,080	956,673	12,900	325,177	63,500	935,731	32,600	195,655	.....	391,195	4,160
New Zealand	127,254	28,300	27,493	16,550	34,256	47,500	183,118	63,200	78,354	6,380	47,844	6,380
Norway	72,121	21,850	20,356	12,700	9,661	7,860	41,683	18,800	115,279	25,700	64,795	1,150
Spain	156,333	17,300	59,097	45,500	39,678	42,500	369,155	104,200	833,516	470	196,380	7,880
United States	.....	22,300	.....	15,360	.....	9,700	.....	1,550	.....	.....	.....	450
Great Britain	264,036	.....	90,035	.....	156,185	.....	722,346	.....	108,970	.....	13,941	.....

Station Arrester Deliveries Under Two Months

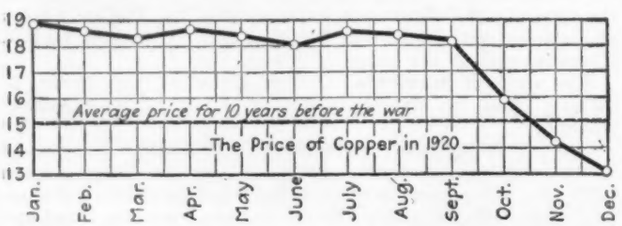
WITH shipments of the station type of lighting arresters running up around four, six and even eight weeks, depending upon the type of arrester and on the manufacturer, it does not seem to be too early to consider the advisability of placing orders for delivery and installation before the spring storms may be expected to set in. Parts for repair purposes and for replacements require virtually the same length of time.

Buying has not been heavy for this equipment, but already many stations have made known their needs and are awaiting shipment. Other stations are still behind and run a chance of having their equipment held up by longer deliveries if they put off their ordering until the factories begin to fill up their production capacity. There is reported a shortage in high-voltage porcelain for use with lightning arresters of the station type, and this is not surprising when the long deliveries of regular high-tension insulators are considered.

Copper Price Below Ten Years' Pre-War Average

FROM the accompanying curve, prepared from figures compiled by the *Engineering and Mining Journal*, there is shown very clearly the course taken by copper during the year just passed. These figures give the average prices for each month of electrolytic copper f.o.b. refinery. The present spot market is quite inactive, and producers are holding at a nominal price of 12.75 cents.

On all sides is heard the criticism that prices of materials are far above pre-war prices. Copper is now quoted well below the average of the ten years before the war, which was approximately 15 cents, delivered. Indications seem to point to a slowly advancing price. Improvements in foreign exchange are expected to assist buying greatly. Manufacturers who expect to build up rapidly a future trade by lower costs must, it would appear, insure themselves against higher cost of raw materials by taking advantage of rock-bottom prices. There are many indications to encourage the belief that copper is now lower than it will be at any other time, certainly during the coming year.



Long Shipments in Porcelain Predicted

THE low-voltage porcelain market has been one of the longest to hold in a stable position, and even now, as far as can be learned, has shown only one instance of a price reduction, and that is a 5 per cent drop in a line of special porcelain. Buying of knobs, tubes and cleats is rather quiet, and the market for special porcelain for parts of other electrical apparatus is in the same state. At the same time, there is an endeavor among certain porcelain manufacturers to get in enough special porcelain business to tide over until the standard lines open up again.

In some quarters there is a certain amount of standard porcelain being made up for stock against the day when the building industry shall again make its demands for wiring materials, and quick shipments will prove of much value. In view of the building which porcelain makers see in the offing, their advice to the trade is to get in requisitions sufficiently far in advance to permit of manufacturing before the need actually becomes acute. Failure to do this, it is pointed out, will certainly result in long and unsatisfactory deliveries once the urgency is apparent.

From some quarters comes the report of a shortage of certain of the raw materials, even to the extent that the mills are now unable to run full time under present orders. A few back orders are still to be filled. No chance of a price recession is seen in the near future, according to the manufacturers. While from some quarters knobs, tubes and cleats can be shipped from stock in not too great amounts, in other quarters tubes are taking from four to six weeks to ship. Knobs and cleats are generally in fair stock. Low-voltage insulators can be had on shipments ranging around thirty to forty days.

Lamp Companies Operating on a Four-Day-Week Basis

IN LINE with what is reported to be a general stock-reducing policy, the mazda lamp companies are operating on a basis of four days a week. Under present conditions of business the companies feel that only as light stocks as can be carried safely should be accumulated, and in order to eliminate as far as possible the necessity for discharging workers, the shorter week has been adopted. The manufacturers expect it to be only temporary, however, possibly only three weeks or so. Orders in general have fallen off, although December has been reported a heavy month. All new building operations at the Fort Wayne works of the Edison Lamp Works have been discontinued temporarily.

The Metal Market Situation

FOLLOWING the firmer tone which developed in the copper market over the first two or three weeks of the year, a reaction has recently set in. Buying interest has now almost entirely ceased and a weaker tone to prices is evident. Export orders, which were recently being booked at a substantial rate, have fallen off too. Producers are now offering electrolytic copper at 12.75 cents delivered for prompt shipment and 13 cents over the first quarter. The coming sale of 48,000,000 lb. of surplus brass cartridge cases by the government is felt to have a depressing effect upon buyers. The outside market is quiet with but little copper offered, as producers are now the cheapest sellers. Standard spot copper under a weak market declined more than £2 10s. at London, to £67 15s. during the fortnight. This is the lowest price touched in London since 1915.

The market for lead is quiet at present, prices remaining unchanged. Little buying interest in zinc is evident, the market being dull and easy in tone with a fractional decline in the price of spot metal.

The scrap market continues lifeless. Some of the dealers are buying metals not because there is any great demand for scraps, but probably to hold for a rise in price, realizing the bottom prices at which most metals now stand. Some of the smaller brass foundries are buying here and there, but the brass industry is quiet. One of the brass companies has just decided to pass its dividend on common stock until manufacturing and general business conditions are more settled in the brass industry.

NEW YORK METAL MARKET PRICES

	Jan. 18, 1921	Jan. 25, 1921
Copper	£ s d	£ s d
London, standard spot	70 7 6	67 0 0
	Cents per Pound	Cents per Pound
Prime Lake	13.75	13.50
Electrolytic	13.00 13.12½	12.75
Casting	12.75	12.50
Wire base	15.75	15.75
Lead, trust price	4.75	4.75
Antimony	5.10	5.37½
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	11.50	11.50
Zinc, spot	5.95	5.76 5.80
Tin	35.00	32.75
Aluminum, 98 to 99 per cent	28.30	28.30

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	11.00–11.25	11.00–11.25
Brass, heavy	6.00– 6.50	6.00– 6.50
Brass, light	4.00– 4.50	4.00– 4.50
Lead, heavy	3.75– 4.00	3.75– 4.00
Zinc, old scrap	3.00–3.25	3.00– 3.25

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

FROM one and another part of the country come the faintest signs that the times are beginning to turn—not that any great increase of business is reported, but the traces of better business are apparent. This is still the dull season in other places, and it is rather expected to be so.

Stocks as a whole are sufficient for all present demands and in many instances are a little too high for comfort. Still, there is little evidence of real slashing in the general wiring line. Price recessions on the part of manufacturers have about stopped for the moment.

Credit conditions remain as before, but with constant application collections are coming in in no less degree. While many automotive plants have begun operation again, some steel plants and others in the electrical industry have curtailed a bit. There is more labor in the West and Middle West than there is work to do. Car loadings are decreasing, and railroad yards and shops are releasing men.

NEW YORK

Here and there appears a glimmer of brighter times in the prevailing gloom of the market, but trade as a whole is naturally, and perhaps rightfully, loath to put too much trust in these "signs." This week, for instance, one of the largest jobbing houses in the country reports a general slight improvement in sales. Another large house reports a good volume of business. Elsewhere, however, trade for the week continues on the same quiet plane as heretofore.

Prices, temporarily at least, are somewhat steadier in so far as manufacturers are concerned, and no further reductions are reported this week. The price situation, however, is the bone of much contention among jobbers and retailers. Competition is of the very keenest sort, and price cutting is rather freely resorted to by many houses. In an attempt to help stabilize prices several appliance and washing-machine manufacturers are reported to have guaranteed prices for periods varying from three to five months.

Stocks on many of the staple lines are, on the whole, larger than jobbers would like to see, despite the fact that virtually no goods have been on order for some time. Collections have not changed materially and still remain unfavorable.

Heaters.—Recent cold weather has helped move supplies to some extent, but the general demand is not very good. The price of the Majestic heater was dropped from $12.50 to $12, effective Dec. 22. Price cuts are being freely made by retailers as stocks are quite large.

Conduit.—Demand is light and the supply plentiful. In 2,500-ft. quantities the price of ½-in. black ranges from $70 to $79 and the price of 1-in. black from $137 to $155 per 1,000 ft.

Flexible Armored Conductor.—Stocks are more than adequate for the light demand. Competition among sellers is keen, at prices ranging from $61 to $66 per 1,000 ft. for No. 14 two-wire, double-strip.

Rubber-Covered Wire.—Supplies are held down to a fairly normal level under the light buying. Prices are nominal as quotations are more or less readily shaded. In 10,000-ft. lots, jobbers quote No. 14 from $7.95 to $9 per 1,000 ft.

Tape.—A plentiful supply is on hand, but demand is weak. In 100-lb lots friction tape is quoted from 45 to 54 cents and rubber from 41 to 45 cents per pound, depending upon the grade and manufacturer.

Lamp Cord.—A few jobbers report fair sales in small lots, but general buying is weak and stocks are large. The price of No. 18 twisted in 500-ft. quantities ranges from $20 to $26 per 1,000 ft.

Vacuum Cleaners.—One of the large department stores last week offered a sale of 500 cleaners of a well-known make, which lists for $52, at $27.75 each, a reduction of about 47 per cent.

Lamps.—Although curtailed operation of some manufacturers' plants would seem to indicate a lessening demand, jobbers in this territory report that sales continue good with no let-up in sight. The supply is favorable.

CHICAGO

Several things happened during the past week to accentuate and prolong the uncertainty which is felt in Chicago in regard to the immediate future of business. The indictment of many union heads, contractors and woodworking-mill owners under the Sherman act for restraint of trade, alleged to have added many millions to the cost of building in Chicago in the past six years, is the most important one.

No improvement is noted in the volume of building permits issued. Eliminating the three-million-dollar permit mentioned last week, the average for the past fifteen weeks has been $650,000, compared with an average of $1,450,000 a week for the same period in the last ten years. Permits now being issued are confined almost exclusively to alterations, repairs or small garages and other structures of that general kind. The universal sentiment expressed among prospective builders is an intention to wait and see what the next few weeks will bring forth in the matter of prices and labor costs. A conference of building-material men held here this week at the call of the lumber interests passed a resolution calling for a general reduction of building costs.

The announcement on the part of the Pennsylvania, Baltimore & Ohio, Erie and Chicago & Alton railroads that sharp reductions are to be put into immediate effect in the number of men employed presages decreased buying power in the community. On the other hand, certain of the steel plants which had closed are resuming operations and nearly all of the Detroit automobile plants are resuming. Reductions in pay have been accepted by the employees of several large concerns in Chicago.

In the electrical market prices remain unchanged in general, and business is very quiet. Retailers, even though stocks are low, are refusing to stock up until convinced that prices will be no lower. Contractors, because of the building slump, have little to do and contractor-dealers are therefore having a quiet time. Inquiry in all lines is active, but it seems to be caused largely by curiosity or a desire to establish values in figuring inventories. Collections are hard and reported as ranging around sixty days.

Electric Signs.—Standard sign units are unchanged in price, but cost of installation is slightly reduced on account of the decrease in certain material prices. Many forms of business not formerly using this method of advertising are now installing electric signs, large and expensive installations being favored.

Fans. — Manufacturers and jobbers are starting after spring business. Slight advances over last year's lists are known to have been made effective in some cases. Reduced industrial demand will probably induce keen competition.

Heating Appliances.—Summer specialties are beginning to be pushed, and reductions are effective on several lines. The cuts are not uniform in the several lines, nor are all items in any one line similarly affected. In general prices are from 8 to 15 per cent below former quotation. Retailers' stocks are low, and good business, it is felt, should result from new prices and renewed sales effort.

Washing Machines.—Retailers report fairly steady trade, but a universal demand for guaranteed prices. A larger proportion of buyers are taking extended payment privileges than was formerly the case.

BOSTON

Electrical trade in Boston has been sharply cut down by a strike in the building industry which began last week upon the refusal of employers to grant higher wages than 90 cents per hour in leading trades. The unions recently refused to extend agreements on the basis of $1 per hour, and it is reported that great dissatisfaction exists among the rank and file with the present leadership. Owners, contractors and jobbers appear determined to stand together against any present increase in wages. Electrical contractors are marking time and buying virtually nothing except just immediately needed supplies and appliances. Conditions outside of Boston are improving here and there, notably in the Fall River textile mills and in Rhode Island. Buying by shoe manufacturers is reported better in electrical jobbing circles. Collections are poor and delayed payments are made up only by vigorous work. Local stocks are large in many lines, but fittings for flexible armored conduit are a little hard to get. Prices hold at about last week's levels.

Lamps.—Business has held up remarkably well. Stocks are in good shape and prices are steady outside the miniature field. A representative jobber figures that the recent advance in prices represents an increased cost of about 11 per cent on his consignments.

Motors.—Current necessities are being met without serious difficulty. The market for used motors is very dull.

Fuses.—Stocks are in excellent shape to meet increased business. Sales at list less 30 per cent are common in inclosed non-renewable types, but the demand is very quiet.

Flexible Armored Conductor.—The market is sluggish. No. 14 double-strip sells for $72 per 1,000 ft. in small quantities and for about $67 per 1,000 ft. in 5,000-ft. lots.

Ranges.—Deliveries are coming through from the factories for 1921 business, and a fine year's sales are anticipated when the season opens. Improved designs make price comparisons difficult, but no general change is seen in quotations.

Connectors.—Fittings for flexible armored conductor are a little hard to obtain and are selling for list less 10 per cent.

Lamp Cord.—Quiet demand exists, with fairly good stocks well distributed. No. 18 cotton-covered cord sells for $28 per 1,000 ft. in 1,000-ft. lots and for $32 in less-than-coil shipments. Silk cord brings $52 per 1,000 ft. in less-than-coil lots and $46 in 1,000-ft. consignments.

Rigid Conduit.—Better stocks exist than for some time. The demand is very light. Representative prices Monday were $85.15 per 1,000 ft. for ½-in. black pipe in less than 2,500-lb. lots and $89 for galvanized pipe of this size.

Wire.—Very little wire is moving except for mill and central-station use on a small scale. No change is noted in prices compared with last week.

Appliances.—Washers are moving well where the field has been intensively cultivated. Portable lamps, radiators and tableware are not in large demand at present. Cleaners are moving sluggishly, and immediate deliveries can be made from some factory stocks.

ATLANTA

There is to be noticed an increasing number of purchasers, but they are placing their orders for smaller quantities than has been their practice heretofore, the quantity being approximately 50 to 60 per cent below former purchases. Inquiries, however, are being received for material in considerable quantities from utilities, municipalities and industrial plants. Local contractors report their work holding up unusually well, the more progressive having about as much work as they can reasonably handle, and they have not reduced their working force. This is accounted for largely because of the considerable number of fires in this section recently. The strike of the building trades mentioned last week has virtually come to an end, and no construction of moment is being interfered with on this account. Several of the jobbing houses are laying their plans for spring activities and are planning sales campaigns for special lines of apparatus, such as washing machines and vacuum cleaners, etc.

While collections are reported as very slow on orders delivered in the late fall, jobbers state that they are meeting with very satisfactory success on collections for material sold and shipped within the past two weeks.

Switches and Outlet Boxes.—The last few days have seen a sudden spurt in this line, possibly accounted for by the price reduction of 15 per cent. Deliveries have not caught up in this line, and while some fair stocks accumulated during the slack period, they were insufficient to provide a full line of the more popular sizes.

Fans.—In face of the 10 to 15 per cent increase in the price of fans for the coming season, jobbers are estimating next season's business at 60 per cent of that of last year. Jobbers are placing orders for their requirements on this basis, but are, of course, making practically no sales to retailers as yet.

Lamps.—The completion of buildings started in the early fall has caused a well-sustained demand for all sizes of lamps, the 40, 60, 75 and 100-watt sizes being particularly in demand. No shortage is reported and stocks are in good condition, with shipments from four to five weeks.

Non-Metallic Flexible Conduit.—The heavy price reduction has served to create activity in this article. All firms report heavy stocks, with little or no goods moving. Prices, $\frac{3}{2}$-in., $2.50 per 100; ½-in., $2.75 per 100.

Porcelain.—Deliveries on porcelain, while showing some improvement, are still unsatisfactory, and as a result stocks are more or less broken up. While the demand is reported to be holding up fairly well, it is off from its prior volume, the greatest demand being for "Nail-it" knobs and $\frac{5}{8}$-in. by 3-in. tubes. Price on standard packages, $\frac{5}{8}$-in. by 3-in. tubes, $1.09 per 100; No. 1 "Nail-it" knobs, $3.10 per 100.

Wire.—Jobbers report more activity in rubber-covered wire than in almost any other line of material. This is accounted for in a measure by the opinion that prices have reached rock bottom and an advance is expected. Stocks and shipments are both reported as satisfactory, deliveries being on the basis of four to five weeks on carload lots. No. 14 rubber-covered is priced at $9 per 1,000 ft.

ST. LOUIS

Very little change is to be noted in conditions as compared with the previous week. Orders received daily have averaged about half the number received during December, orders billed being slightly above this, because there are a few items on which back orders still exist, such as linemen's tools and power transformers. There have been a large number of inquiries, however, a surprising number of them from industrial companies, showing that a good many manufacturers are planning to take advantage of the decreased production by repairing their plants and making alterations. Inquiries have been received also from public utilities, pointing to a good deal of work in that line in the spring.

Prices are firm on most items, the leaders in the jobbing and manufacturing ends of the industry not making any concessions. There have been a few instances of special price cuts by the smaller people, but this tendency is not general enough to have much effect on prices.

Collections have become a little better owing more to the hard work of the credit departments than to any specific improvement of business or money conditions. The average reported is closer to sixty days than it is to seventy, with one jobber reporting that his collections are down to about fifty days.

Rigid Conduit.—The drop in manufacturers' prices has been mirrored by a corresponding decrease in jobbers' quotations, the ½-in. black conduit being quoted at $77 per 1,000 ft. in 5,000-ft. lots, the ¾-in. black at $102, and the 1-in. black at $150. Jobbers' stocks are more complete than they have been for some time, and there is little difficulty in getting the smaller sizes and none at all in obtaining sizes over 1 in.

Wire.—A stagnant condition still obtains in the wire market and has extended its effect even more noticeably

than before to rubber-covered wire. Current quotations for rubber-covered are between $8.50 and $9 per 1,000 ft., with few sales. Weatherproof wire is quoted on a 22-cent base and bare wire on an 18-cent base, with demand for both inactive. Many manufacturers here have surplus stocks of magnet wire, and this is holding down jobbers' sales.

Knobs and Tubes. — Quotations have not changed and appear to be as firm as ever, though slight decreases have been noted elsewhere. Tubes measuring 3 in. x $\frac{5}{8}$ in. are quoted at $9.90 in lots of 1,000 while the 5½-in. new code rail knobs are priced at $32 per 1,000. Stocks are large and demand is below normal.

Heaters.—Both jobbers' and dealers' sales have been light during the past week under mild weather conditions. Stocks are good.

Linemen's Tools.—Jobbers are still unable to promise delivery of Klein's tools under six to eight months, but are fairly well supplied with tools of other makes.

Meters.—Stocks have bettered considerably and deliveries are much more prompt, being promised in from two to four weeks. Demand has lightened somewhat with the decrease in extension work. Central stations are still calling for them, but not so strongly as formerly. There is more of a demand for the direct-current than for the alternating-current-type.

Sockets.—Sockets are moving, though slowly. Jobbers' stocks are more than ample to take care of the demand.

SAN FRANCISCO

Building is slower because of the widespread rains, which at the same time are preparing the state for what appears to be an exceedingly prosperous year. Business in general is slower too, and all jobbers and dealers recognize that it is the duty of every working unit of the electrical industry to improve the morale of the purchasing public.

The building situation is desperate. This condition has revived building speculation, which, after a lapse of several months, is once again very prevalent.

Credits are being very cautiously extended. Banks and loan agencies seem to be tightening on the appliance business and are requiring gilt-edged references and guarantees both for blanket and individual contracts. Collections are fair because of vigorous following up.

Rubber-Covered Wire.—The recent drop averaged about 14 per cent. Local stocks are good. No. 14 single-braid solid is selling for $9.25 per 1,000 ft. in 5,000-ft. lots, with 50 cents advance per 1,000 ft. in coil lots.

Heating Appliances.—The Edison companies have distributed new price schedules canceling all former heating contracts. Heretofore Edison appliances have been marketed on the basis of yearly contracts with a maximum discount of 30 and 7½ per cent for $1,000 net per year f.o.b. Pacific Coast terminals. It was found that many small deliveries proved very expensive, and henceforward the dealer's discounts will depend upon the value of each individual order. The new prices range from 30 per cent for six assorted devices to 30 and 10 per cent for fifty assorted devices. These discounts have caused a great deal of comment among dealers, who claim that there are very few California dealers who can reach the maximum and who object to paying the shorter discount for small special orders. These discounts, however, are somewhat like those which have been used by the American Electric Heater Company for several years past east of the Rockies and for several months along the Pacific Coast, its maximum discount being 30 and 7½ per cent for $250 list assorted because its grading is by list value instead of by pieces. The trade has been circularized by the American Electric Heater Company to the effect that not only does it not expect any drop in heating-appliance prices, but furthermore that it does not foresee signs of any such drop in the near future, because its labor and material costs average 100 per cent over those prevailing in the pre-war period. Heating business in general has slowed up because of rather large and well-assorted stocks carried over by most dealers from the holiday season. There is a considerable demand for electric curling irons, of which three or four makes are being carried on the Coast.

SEATTLE—PORTLAND

Price recessions spoken of from other sections of the country have not been noticed to any extent in Seattle and the Puget Sound district. As a whole sales during January to date compare favorably with those of last January, and the optimistically inclined state that the outlook for spring business is promising. New construction during the past week showed an excellent increase over any previous week during the past two months.

Merchandising stores in Seattle as a whole are making no effort to replenish stocks of domestic appliances, apparently preferring to wait until period of price recession is ended. Some few are known to be carrying stocks considerably in excess of actual demand, because of light holiday buying.

Bids for contracts to furnish the city of Seattle with hydro-electric machinery, needed at the Skagit River municipal power project, estimated to cost about $1,000,000, will be opened by the Board of Public Works about Feb. 18. Mayor Caldwell suggested that because of dearth of construction equipment houses should be willing to accept bonds in payment for machinery, and urged that the successful bidder be permitted to buy an additional million dollars of bonds at par, intimating that certain prospective bidders had signified their willingness to accept bonds in payment.

Lumber and shingle mills and logging camps in the Puget Sound district are opening up, following the mid-winter shutdown, many starting on a three-day schedule. The non-employment situation is but slightly improved, however, there being between 7,000 and 10,000 idle men in Seattle alone. Portland manufacturers report stocks in better shape than a year ago. In some lines there is much larger stock than last January, and in others they are still short.

The general situation is much improved. They are catching up with back orders on nearly everything which is ordinarily carried in stock in this section. The principal shortage is in transformers and meters. The credit situation is very tight. Collections, however, continue to be reasonably good, running from 60 to 80 per cent each month.

SALT LAKE CITY—DENVER

Jobbers are now beginning to foresee a price recession on electrical merchandise that is quite general in its scope. Announcement of reductions on several lines have already been made, and factories have advised their jobbers of several other cuts that have not yet affected the jobbers or dealers.

It is believed that the inactivity in construction work, amounting almost to stagnation, will soon have passed the low mark. Building materials are being radically reduced in price, which is likely to be a stimulus to building when spring arrives. Non-employment is quite common and widespread throughout the mountain country, although there are few cases reported where large groups of laborers have been laid off. Nearly every business concern is continuing operation, but on a basis of a reduced labor force.

Bare Copper Wire.—The market on copper is still off and the price of wire has reached a low mark. The tendency downward is being reflected also in rubber-covered wire products.

Rigid Conduit.—A recent cut of 10 per cent has taken effect. The slump in building has reduced the demand almost to the vanishing point. Stocks are more than adequate.

Non-Metallic Flexible Conduit.—The factories have announced a reduction, but jobbers are trying to dispose of stocks on hand before applying the new price schedule. At best they will probably have to take a loss.

Motors.—Jobbers are well stocked. Dealers place small orders, and the demand is fairly steady. There are no price reductions reported.

Appliances.—One of the largest dealers of the Intermountain region, with a chain of several stores, reports that more appliances are being sold now than were sold during the corresponding period of a year ago.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Governor Harding Selected to Head Foreign Trade Body

The selection of W. P. G. Harding, governor of the Federal Reserve Board, as president of the recently formed Foreign Trade Financing Corporation was announced at a luncheon of the Merchants' Association of New York on Jan. 19. This hundred-million-dollar corporation, with $1,000,000,000 available through the issuance of debentures, is expected to complete its organization soon and to take a big step forward in reviving the foreign trade of this country on sound financial lines.

New England Jobbers Attempt to Stimulate Business

Under the caption "The Truth About the Prices," leading electrical supply jobbers in Maine, New Hampshire, Vermont, Massachusetts and Rhode Island co-operated on Jan. 24 to publish a newspaper display advertisement emphasizing the stability of present prices for electrical household appliances. The plan sets forth the efforts of the electrical industry to keep prices as nearly normal as possible during the war period and pointed out the comparatively small advance attained in this field in comparison with the prices reached by many other commodities. Relatively small decreases in electrical appliance prices are to be looked for in the next year, it was stated, and there was featured the actual money-saving characteristics of certain kinds of equipment, irrespective of present prices and possible small future reductions. The largest electrical jobbing houses in the Northeast and not a few smaller establishments are represented in this co-operative activity to stimulate business.

Security Subscriptions by Employees Large

Employee subscribers to stock and bond offerings of two of the larger electric manufacturing companies are showing gratifying returns. The Western Electric Company has announced that those employees to whom the privilege was given of subscribing on the installment plan to the corporation's new five-year 7 per cent convertible gold bonds have taken $2,600,000 worth of the securities. There were 6,650 subscribers, or about one employee in four. The heaviest subscriptions were reported from the Hawthorne works.

From the final figures of the General Electric Company's 8 per cent stock offering to employees it is shown that 95,396 shares were purchased by 30,747 subscribers, which was about 36 per cent of the total number of employees just before Christmas.

Course in Exporting Proposed

A course to be devoted to the training of export clerks, going minutely into detail concerning the various duties performed by them, and not touching upon export salesmanship or executives, is being contemplated by Joseph McElroy, export sales manager of Pass & Seymour, Inc., and A. H. Frique, export sales manager of the Solo Brush & Broom Company. It is expected to open on Feb. 8 at the Merchants' and Bankers' Business School at 37 East Fifty-eighth Street, New York City, and run for three months. Export packing, shipping, documentation, credit, financing, insurance, the use of codes, export office routine and correspondence will be covered.

Carter Electric in New Quarters

The Carter Electric Company, Atlanta, Ga., has taken up new quarters in its just-completed warehouse on Mangham Street. The new building, which provides the company with nearly 60,000 sq.ft. of floor space, was described in the Dec. 18, 1920, issue of the ELECTRICAL WORLD.

Washing Machine Association Elects Officers

Optimism regarding the future growth of the washing-machine business was the spirit of the opening sessions of the second annual convention of the American Washing Machine Manufacturers' Association, held Jan. 19-20 at the Hotel Sherman, Chicago. Greater effort toward promoting the idea of laundering at home with the help of the washing machine was arranged for by the appropriation of a larger sum for educational work, including the printing and distributing of six instructive circulars. Reports of President H. L. Barker, Secretary E. B. Seitz and Assistant Secretary Mary E. Keown were presented. Following a well-attended banquet, R. D. Hunt of the Dexter Company was elected president. The other officers will be: First vice-president, W. J. Conlon, Conlon Electric Washer Company; second vice-president, J. P. Monahan, Blackstone Manufacturing Company; third vice-president, Silas Altorfer of Altorfer Brothers Company. The executive committee, elected to serve one year, is: Howard Power, H. F. Brammer Company; J. D. A. Johnson, Michigan Washing Machine Company; S. F. H. Bergman, One-Minute Manufacturing Company; Elmer H. Maytag, Maytag Company; Louis A. Dietz, Boss Washing Machine Company.

Engineers of Twenty Years' Standing Incorporate

The Fargo Engineering Company, Jackson, Mich., a consulting engineering firm which has been active in water-power, steam-power and general industrial work in the Middle West for the last twenty years, has filed articles of incorporation with a capital stock of $50,000, all paid in. The officers of the company are: William G. Fargo, president; Horace S. Hunt, vice president, and Rolla G. England, secretary-treasurer. The company announces that it has engineering work under way in various parts of the United States and Canada. Practically all the designing and construction work of the Consumers' Power Company was done under the supervision of this company.

Salt Lake Jobbers Banquet Contractor-Dealers

The electrical jobbers of Salt Lake City, consisting of the Capital Electric Company, the Intermountain Electric Company, the Mine & Smelter Supply Company and the Western Electric Company, had as their guests the contractor-dealers of that city at a dinner at the Hotel Utah on the evening of Jan. 5. J. A. Kahn, general manager of the Capital Electric Company, was chairman, and C. B. Hawley, general manager of the Intermountain Electric Company, acted as toastmaster. Addresses were made on the electrical jobber, the electrical dealer, the central station, co-operation, the business outlook for 1921 and the Rocky Mountain Electrical Co-operative League. A splendid spirit of optimism prevailed among the fifty-eight who were present.

Frankel Light Expands Market

The Frankel Light Company, 5016 Woodland Avenue, Cleveland, has expanded its market so that it has a representative now in virtually every state in the Union and expects to fill in the remaining states within the next few weeks. The company's special connection is with the contractor-dealer trade in the sale of fixtures.

Northland Electric New Name of Supply Jobber

After having been in operation as a distributer of electrical supplies for ten months and having done half a million dollars' worth of business, the Triumph Electric Company, 211 South Third Street, Minneapolis, Minn., announces a change in name to the Northland Electric Supply Company. This change is

the result of a court order because of the similarity in name to that of the Triumph Electric Company, Cincinnati, manufacturer of generators and motors.

Coffield Washer Triples Plant and Sales Force

While the Coffield Washer Company, Dayton, Ohio, has just moved into a much larger plant, which has a capacity of about triple its previous production, information from the company on the outlook for washing machines is that this additional capacity will be all too little in view of the enthusiastic and optimistic attitude throughout its trade. At the same time with its increased productive organization the company has increased its selling organization in proportion. Furthermore, selling arrangements have recently been made in new territories with several long-established distributers.

Southern Manufacturers' Mexican Business Increasing

In connection with trade in the countries just south of the United States the Liberty Manufacturing Company, New Orleans, announces that the percentage of its Mexican business is increasing at a rapid rate and is many times larger than it was the past year at this time. The company, manufacturing switches, switchboards, electric signs, incubators, etc., is extending its territory to cover the entire South and the Central American countries. Moreover, a sales office has been opened recently at 511 Carondelet Street, New Orleans, as the factory is on the outskirts of the city.

The Inland Wire & Cable Company, Cleveland, is planning to erect a new plant, 100 ft. x 350 ft., one story, at Hammond, Ind., to cost about $100,000.

The A. C. Gilbert Company, Blatchley Avenue, New Haven, Conn., manufacturer of electric fans, toys, etc., is planning to erect a one-story addition, 26 ft. x 240 ft., to its plant.

The Mutual Electric & Machine Company, Detroit, has recently increased its capital stock from $100,000 to $500,000. The item published on Dec. 25 relative to the increase in capital stock of the company gave the address as Wheeling, W. Va. The office at Wheeling has been discontinued for some time.

The Electric Appliance Company, Chicago, held a sales conference from Jan. 3 to Jan. 8, which was attended by the entire sales force. Sales managers of nationally known electrical manufacturers were invited to talk to the men.

The Leonard Electric Manufacturing Company, Cleveland, manufacturer of switchboards, panelboards, etc., is established in its new building at 3907 Perkins Avenue, where it has twice the floor space and much better facilities for serving its customers. The Williams-Beasley Company, 53 West Jackson Boulevard, Chicago, and 1626 Chemical Building, St. Louis, is the representative in those two cities for safety switches manufactured by the company.

The Maring Wire Company, Muskegon, Mich., manufacturer of enameled and cotton-covered magnet wire, announces the appointment of the R. W. Lillie Corporation, 30 Church Street, New York City, as its Eastern representative. The Boston office at 176 Federal Street is in charge of H. D. Steele.

The MacGillis & Gibbs Company, Milwaukee, manufacturer of cedar posts, poles and railway cross-ties, which has completed its twenty-second year in business, is distributing a booklet entitled "Poles of Cedar," in which it gives an outline of its activities and short sketch of its officers. J. E. Gerich, president and general manager, was one of the incorporators of the company and was made president and general manager in 1905.

The General Electric Company, Schenectady, N. Y., is planning to erect a machine shop, 50 ft. x 200 ft., in Atlanta, Ga.

The James Leffel & Company, Springfield, Ohio, manufacturer of turbines, waterwheels, etc., has opened a sales and engineering office at 615 Plymouth Building, Minneapolis. M. S. Bassett, who has been connected with the engineering and sales departments at Springfield for fifteen years, will be in charge.

The Webster Electric Company, Racine, Wis., manufacturer of magnetos, etc., has filed notice of increase in capital stock from $600,000 to $1,000,000.

The Herman Andrae Electrical Company, Milwaukee, has filed notice of increase in capital stock from $50,000 to $100,000.

The Reliance Electric & Engineering Company, Cleveland, has removed its Boston office from 10 High Street to 200 Devonshire Street. Langdon S. Simons is in charge.

The Edward Valve & Manufacturing Company, 72 West Adams Street, Chicago, is planning to rebuild its plant at East Chicago, Ind., recently destroyed by fire. The loss is estimated at about $350,000.

The International Time Recording Company, Endicott, N. Y., has leased the second floor of the building at 846 North Broad Street, Philadelphia, for new headquarters.

The Champion Engineering Company, Kenton, Ohio, manufacturer of electric traveling cranes, has appointed A. E. Hogrebe, mechanical and electrical engineer, sales engineer for the Baltimore territory. Mr. Hogrebe has been identified with the electric traveling crane business since 1891, having been connected with the Yale & Towne Manufacturing Company, Brown Hoisting Machinery Company, Niles-Bement-Pond Company and Pawling & Harnischfeger. Since 1917 he has been with the Chesapeake Iron Works, having severed his connection with that company recently.

The American Enameled Magnet Wire Company, Muskegon, Mich., has field notice of increase in capital stock from $250,000 to $600,000.

The Daniel M. Luehrs Company, Cleveland, Ohio, recently organized to engage in industrial engineering, has established office and laboratories at 2015 East Sixty-fifth Street. Daniel Luehrs, president of the company, was formerly with the McCreary Engineering Company, Toledo, Ohio, and later with the American Blower Company, Detroit. The laboratories will be in charge of C. A. Buld, metallurgist, who was with the General Electric Company for ten years, and E. M. Huemann, chemist, who has been connected with the chemical laboratories of various industrial companies. H. W. Hough, formerly chief electrical engineer with the Cleveland Electric Illuminating Company, will have charge of the company's electrical work. S. J. Brady, who has had experience with various companies in the design and operation of electric furnaces, is also a member of the company.

The Brunt Tile & Porcelain Company, Columbus, Ohio, has recently made extensions to its works, including the erection of two new kilns and three new buildings, making the total floor space now occupied 70,766 sq.ft. The company has added the States of Louisiana, Pennsylvania and West Virginia to its Chicago office territory.

The Roller-Smith Company, 223 Broadway, New York City, announces the appointment of the J. E. Dilworth Company, 493 South Main Street, Memphis, Tenn., as its representative in the western half of Tennessee, the eastern half of Arkansas and the northern half of Mississippi. The electrical department of the Dilworth company is in charge of E. M. Greeson, who was formerly associated with Fairbanks, Morse & Company and the Sanborn Electric Company, both of Indianapolis.

The Northern Electric Company, 542 St. Clair Street, Chicago, has installed additional equipment to provide for the increasing demand for its products.

The Adamson Manufacturing Company, East Palestine, Ohio, has added a new department to its works for manufacturing all kinds of storage, pneumatic and pressure tanks, welded pipe, battery casings, evaporators, condensers and a large line of arc-welded products.

The Emerson Electric Manufacturing Company, St. Louis, has completed the third unit of its plant and it will be put into operation shortly. The new building is eight stories high and has approximately four acres of floor space. A feature of the new building is the 23,000-volt transformer room.

The Bluebird Division of the Davis Sewing Machine Company, Dayton, Ohio, is the name under which the Bluebird washing machine will hereafter be manufactured. Work has been resumed at the factory in St. Louis, Mo., and preparations are being made for manufacturing the Bluebird washing machine at the plant of the Davis Sewing Machine Company in Dayton. A complete unit of the plant has been set aside for the production of the washing machine.

Cameron Overbagh, 221 West Randolph Street, Chicago, manufacturer of steel boxes, connectors, clamps and fixture studs, is planning to extend the sale of his products to all sections of the country. Until now sales efforts have been confined to the Middle Western territory.

Albert Vestor Sons, Inc., Providence, R. I., announce that W. L. Patterson, sales manager, with headquarters at 1133 Broadway, New York City, will handle their line of fixture parts for the Metropolitan district.

Clemence Brothers, Irvington, N. J., have appointed B. W. Sandback, with headquarters at 5 East Thirteenth Street, New York City, direct factory representative for the distribution of their line of "Sterling Bi-Plex B-X" outlet boxes and "Meleady" loom boxes for the metropolitan district.

The New England Electric Appliance Company, 607 Main Street, Hartford, Conn., has recently been organized to represent the Air-Way Electric Appliance Corporation, Toledo, Ohio, in the New England States.

Foreign Trade Notes

EXTENSION TO NEW ZEALAND POWER STATIONS.—Tenders are invited by the Borough Council of Gisburne, New Zealand, according to the London *Mail*, until March 31 for work in connection with extension to the electric power stations, including two turbines of 3,600 hp. each, two 2,500-kva. alternators, two turbines each of 145 hp. and two 100-kw. exciters. Specifications may be consulted at Department of Overseas Trade, 35 Old Queen Street, Westminster, 2. W. 2, London, England.

AUCKLANDS (N. Z.) INVITES TENDERS.—The city of Auckland, N. Z., according to the London *Electrician*, will receive tenders until Feb. 22 for furnishing and installing one 3,000-kw. and one 5,000-kw. turbo-alternator, one 1,500-kw. and one 500-kw. rotary converter, switch gear and transformers, water-tube boilers, conveyor pumps, pipe work and cables. Specifications may be obtained from Preece, Cardew & Rider, consulting engineer, 8 Queen Anne's Gate, S. W. 1, London, England.

SOUTH AFRICAN MARKET FOR AMERICAN ELECTRICAL GOODS.—The Bureau of Foreign and Domestic Commerce, Washington, has issued a 117-page Special Agents' Series No. 205, entitled "Electrical Goods in British South Africa." The publication describes methods of selling electrical goods, gives selling terms, discusses the market for specific classes of electrical goods, etc.

SOUTHLAND ELECTRIC POWER BOARD PLANS DEVELOPMENT IN NEW ZEALAND.—A. W. Rodger of Invercargill, N. Z., author of the Electric Power Boards act, which embraces both private and public ownership of utilities, who is now in the United States, has outlined to a representative of the ELECTRICAL WORLD the procedure being followed in connection with his plans for developing the water powers of New Zealand. His district was the first one to take advantage of the new law and, as chairman of the Southland Electric Power Board, he is on a trip to England and America to raise $7,500,000 to buy materials and apparatus for a 20,000-hp. hydro-electric development (two 3,000-kw. units initially), 150 miles of 66,000-volt line, 1,500 miles of 11,000-volt line, 600 miles of 400-volt line and wiring materials and appliances for 6,000 rural homes. The government has advanced money for the development work, which is now well under way. All poles have been bought, as have one-third of the insulators. Nine hundred tons of copper wire and 500 tons of galvanized-iron wire are among the items still to be purchased. Of the $7,500,000 required, $1,500,000 is for financing the wiring of homes and the sale of merchandise.

GEORGE C. ROUGH has, it is reported, disposed of his interest in and resigned from the Packard Electric Company, St. Catharines, Ontario, of which he has recently been president and general manager. Mr. Rough plans to continue in the electrical business and to locate in Montreal as manufacturers' representative.

THE DIAMOND STATE FIBRE COMPANY OF CANADA is now handling Diamond F protective papers and is carrying a stock of these at its Canadian branch, 455 King Street West, Toronto. The company is also in a position to manufacture special fiber shapes, such as pulleys, noiseless gears, bushings, washings, etc., at the Kings Street plant.

HYDRO-ELECTRIC DEVELOPMENT IN TASMANIA.—The Electrolytic Zinc Corporation of Australia is offering an issue of £1,100,000 8 per cent cumulative preferred stock, the proceeds of which will be used for the completion of its extensive works at Risdon, Tasmania. The corporation has a contract with the Tasmanian government by which it takes 30,000 hp. at $2 per year for twenty years, with an option at the end of that term for another twenty years. Extensions to the plant will increase the output of electrolytic zinc to 50 tons per day by the end of 1921, and to 100 tons a day by the end of 1922.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A wholesale dealer in electrotechnical lines in Switzerland (No. 34,306) wishes to get in touch with electrical lamp manufacturers with a view to purchasing these products.

A merchant in Ireland (No. 34,313) desires to obtain an agency for the sale of electrical appliances.

A firm of wholesale electrical dealers in India (No. 34,314) desires to receive quotations and information relating to resistance wire in sizes from No. 12 to 36 standard wire gage, and also similar information on ordinary fuse wire.

A merchant in the French West Indies (No. 34,319) desires to secure catalogs in French of articles which he plans to purchase, such as storage batteries, insulated wire, kerosene motors for electric lighting plants, etc.

An importing firm in India (No. 34,324) desires to be placed in touch with manufacturers and exporters for the purchase of electrical goods, etc.

A wholesale merchant firm in India (No. 34,327) desires to be placed in touch with a manufacturer of magneto telephones with a view to obtaining an agency for same.

A consulting engineer in Portugal (No. 34,329) desires to purchase electrical supplies for a municipal lighting plant and street-railway system.

New Apparatus and Publications

STORAGE-CELL TESTER—The Metric Appliance Corporation, 133d Street and Willow Avenue, New York City, is distributing a circular describing its new "Mac" storage-cell tester.

TELEPHONE. — The portable telephone for communication from points along a transmission line is described in a new booklet of the Doble Engineering Company, 40 Central Street, Boston.

LUBRICATION. — "Lubrication of Hydraulic Turbines" is the subject of the leading article in the December, 1920, issue of *Lubrication*, a monthly publication issued by the Texas Company, 17 Battery Place, New York City.

INDUCTION MOTORS. — The Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has issued bulletin No. 1087-C, covering its polyphase induction motors.

INDUSTRIAL HAULAGE.—The General Electric Company, Schenectady, N. Y., has issued an illustrated bulletin, No. 44,251, describing its different types of electric locomotives for industrial haulage.

CALORIMETER.—Publication 876, Cutler-Hammer Manufacturing Company, Milwaukee, Wis., is on the Thomas calorimeter, for recording graphically total heating values of gases.

RUBBER GLOVES.—The Seamless Rubber Company, Inc., New Haven, Conn., distributing a leaflet describing its "Maderite" brand of electric linemen's gloves, etc.

New Incorporations

THE ELECTRIC SIGN FLASHER CORPORATION, Los Angeles, Cal., has been incorporated with a capital stock of $50,000 to manufacture electric flashing devices and other electrical devices. The incorporators are Albert Andrews, G. T. Mahana and M. H. Mahana, Jr., of Los Angeles.

THE SCHOOL CREEK LIGHT COMPANY, Napoleon, Ohio, has been chartered with a capital stock of $10,000 to operate an electric light plant. The incorporators are S. P. Farison, C. V. Farison, W. J. Snyder and William Orthwein.

THE PECOS (TEX.) POWER & ICE COMPANY has been incorporated by J. W. Crowdus, M. E. Neiderkorn and M. E. Crowdus. The company is capitalized at $50,000.

THE SOUTH CENTRAL SERVICE COMPANY, Mitchell, Ind., has been incorporated by Murphy Owen of Mitchell, M. E. Black and Robert M. Cass of Indianapolis, and Clifford M. Hayworth and Winifred Jessup of Richmond. The company is capitalized at $300,000 and proposes to furnish light, heat and water power for Mitchell.

THE SPIELMAN ELECTRIC COMPANY, New York City, has been incorporated with a capital stock of $30,000 by B. M. Asch, S. and M. H. Spielman, 995 Alder Street, the Bronx.

THE ROCHESTER ELECTRIC CARBON BRUSH CORPORATION, Rochester, N. Y., has been incorporated by B. Ferris, J. P. Thompson, G. F. Hixson of Rochester. The company is capitalized at $10,000 and proposes to manufacture graphite products.

THE PHOENIX HYDRO-ELECTRIC CORPORATION, New York City, has been chartered with a capital stock of $350,000 to manufacture water turbines. The incorporators are O. A. Hack, C. E. Goehring and L. Schroeder, 1593 Lexington Avenue, New York City.

THE FOREST HILL WATER, LIGHT & FUEL COMPANY, Forest Hill, Tex., has been incorporated with a capital stock of $8,000 by Everett Cain, J. A. Todd and L. T. Jordan.

THE IMPERIAL ELEVATOR & ENGINEERING COMPANY, 403 South Caroline Street, Baltimore, Md., has been chartered with a capital stock of $25,000 to manufacture elevators, dumbwaiters, conveyors, etc.

THE FARMERS' LIGHT & POWER COMPANY, Delhi, N. Y., has been incorporated with a capital stock of $20,000 by F. W. Thomson, R. S. Marvin, R. Archibald and others. The company proposes to manufacture electrical machinery, etc.

THE NATIONAL ELECTRIC TOOL COMPANY, Pittsburgh, Pa., has been incorporated by John A. Metz, 707 B. F. Jones Law Building; Thomas D. Murray and S. E. Bentley, to manufacture electrical tools and other equipment.

THE UTILITY MANUFACTURING & SALES CORPORATION, Boston, Mass., has been incorporated by Arthur J. Driscoll, Jamaica Plains; George E. Williams and A. C. Drew, Boston. The company is capitalized at $300,000 and proposes to manufacture electrical equipment and do a general electrical engineering business.

THE ANCHOR LITE APPLIANCE COMPANY, Pittsburgh, has been incorporated by Jacob L. Simon, 1409 Park Building; A. S. Goldstein, E. J. Kelsky and others. The company proposes to manufacture electrical appliances and devices.

THE TIMES APPLIANCE COMPANY, New York City, has been incorporated by B. A. and E. A. Allen and E. B. Ingraham, 1475 Broadway. The company is capitalized at $60,000 and proposes to manufacture electrical appliances and devices.

Record of Electrical Patents

Notes on United States Patents

(Issued Jan. 4, 1921)

1,364,495. WIRELESS-TELEGRAPH TRANSMITTER; Henry J. Round, London, England. App. filed Aug. 26, 1920.

1,364,517. FLASH-POINT-TESTING INSTRUMENT; William M. Pestel, Chicago, Ill. App. filed Sept. 10, 1917. For testing coils.

1,364,550. COIN-COLLECTING MEANS FOR TELEPHONE SERVICES; Frederick W. Hall, London, England. App. filed July 8, 1919. Slot receiver.

1,364,643. TELEPHONE-EXCHANGE SYSTEM; Winfred T. Powell, Rochester, N. Y. App. filed Feb. 6, 1919. Special character service.

1,364,672. TROLLEY; Frank Womack, Los Angeles, Cal. App. filed April 5, 1919. Will readily adjust itself to wire.

1,364,673. ART OF INDICATING SPEEDS OF ROTATION; Frank W. Wood, Montclair, N. J. App. filed Dec. 20, 1918. Synchroscope.

1,364,687. RHEOSTAT; Edward M. Bentley, Lawrence, N. Y. App. filed May 9, 1919. Compression.

1,364,688. RHEOSTAT; Edward M. Bentley, Lawrence, N. Y. App. filed July 17, 1919. Variable.

1,364,725. TELEGRAPH SYSTEM; Joao N. Correia, New York, N. Y. App. filed Aug. 14, 1918. For secret service.

1,364,751. ELECTRIC ARC LAMP; Horace B. Grylls, Weybridge, England. App. filed April 1, 1919. Searchlight.

1,364,760. BATTERY GRID; Walter E. Holland and James M. Skinner, Philadelphia, Pa. App. filed Jan. 9, 1919. Relatively thin.

1,364,811. TOASTER; Edwin A. Rutenber, Marion, Ind. App. filed March 20, 1917. Bread turner.

1,364,835. RHEOSTAT; John T. Daniels, Newark, N. J. App. filed Aug. 5, 1920. For low voltage but heavy current.

1,364,847. STOPPING APPARATUS FOR ALTERNATING-CURRENT MOTORS; Harry F. Stratton, Cleveland, Ohio. App. filed July 12, 1919. Quick-stopping.

1,364,852. SYSTEMS FOR GENERATING, STORING, DISTRIBUTING AND UTILIZING ELECTRICAL ENERGY; Edward V. Hartford, Deal, N. J. App. filed June 19, 1912. For automobiles.

1,364,853. ENGINE STARTER; Edward V. Hartford, Deal, N. J. App. filed June 19, 1912. For automobiles.

1,364,854. ELECTRICAL STARTER; Edward V. Hartford, Deal, N. J. App. filed June 28, 1913. For motor vehicles.

1,364,857. ALTERNATING-CURRENT ARC-WELDING SYSTEM; William A. Hall, Yonkers, N. Y. App. filed Sept. 23, 1918. Automatic regulation of voltage.

(Issued Jan. 11, 1921)

15,022 (reissue). HAND LAMP; Charles F. Burgess, Madison, Wis. App. filed Jan. 20, 1914. Protected against accidental lighting.

15,025 (reissue). METHOD OF TESTING AND LOCATING DEFECTIVE MULTIPLE-PART PIN-TYPE INSULATORS; Tomlinson F. Johnson, Jr., Atlanta, Ga. App. filed May 6, 1919. Without interruption of service.

1,364,861. CONSTRUCTION OF ELECTRIC CONDUCTORS; William L. Bliss, Niagara Falls, N. Y. App. filed May 13, 1918. Prevents acid creeping out of battery.

1,364,879. FOOT FOR CONTACT SHOES; Winthrop K. Howe, Rochester, N. Y. App. filed July 13, 1916. Automatic train control.

1,364,909. TELEPHONE SYSTEM; Ray S. Wilbur, Lyndhurst, N. Y. App. filed Dec. 27, 1918. Toll trunk lines.

1,364,953. PROCESS OF PREPARING NEGATIVE PLATES FOR ELECTRIC BATTERIES; Adolfo Pouchain, Turin, Italy. App. filed Sept. 18, 1919. Negative plates of zinc.

1,364,964. MEANS FOR CONTROLLING REPEATERS; John F. Toomey, New York, N. Y. App. filed Oct. 19, 1918. Telephone.

1,364,965. TELEPHONE-CALL-TRANSFER SYSTEM; John F. Toomey, New York, N. Y. App. filed June 3, 1919. Long-distance transmission lines.

1,364,967. RHEOSTAT; Alexander F. Victor, Davenport, Iowa. App. filed July 17, 1919. Means for gradual variation.

1,364,969. SIGNALING SYSTEM; Ray S. Wilbur, Lyndhurst, N. J. App. filed Jan. 2, 1918. Responsive to currents of two different strengths.

1,365,004. TELEGRAPH-PRINTING APPARATUS; Andrew T. MacCoy, Dover, Mass. App. filed Aug. 11, 1917. Selective and synchronizing mechanism.

1,365,032. ELECTROLYTIC APPARATUS; William E. Greenawalt, Denver, Col. App. filed April 29, 1918. Electrolysis of impure copper solutions.

1,365,033. ELECTROLYTIC APPARATUS; William E. Greenawalt, Denver, Col. App. filed Feb. 10, 1919. Copper deposition.

1,365,034. ELECTROLYTIC APPARATUS; William E. Greenawalt, Denver, Col. App. filed June 13, 1914. Maintaining variable valent salts in impure electrolyte at their lowest valency.

1,365,053. PROCESS OF MAKING KETONE BODIES; Carleton Ellis and Alfred A. Wells, Montclair, N. J. App. filed March 18, 1918. From olefins or other unsaturated bodies.

1,365,066. MACHINE FOR WRAPPING AND UNWRAPPING TIRES; Elmer E. Shoopman, Cairo, Neb. App. filed May 13, 1920. With tape of fiber or paper.

1,365,085. MAGNETO-CONTACT-POINT PROTECTOR; Henry A. Bowers, Jamestown, N. Y. App. filed Dec. 8, 1919. To exclude dirt.

1,365,130. STARTING, GENERATING, AND BRAKING SYSTEM; William A. Turbayne, Niagara Falls, N. Y. App. filed Nov. 23, 1917. Automobile.

1,365,140. ELECTROLYSIS; Matthew A. Adam, John Stevenson, Alan T. Mabbit and John Fieldhouse, London, England. App. filed Aug. 31, 1920. Deposit of metals in loose crystalline form.

1,365,141. PREVENTION OF CORROSION; Matthew A. Adam, London, England. App. filed Aug. 31, 1920. For tanks, pipes, pumps, heaters.

1,365,152. ATTACHMENT-PLUG RECEPTACLE; Frank V. Burton, Bridgeport, Conn. App. filed Jan. 15, 1916. To receive jacks of different arrangement.

1,365,157. APPARATUS FOR USE IN TELEGRAPHY OR TELEPHONY; Lee de Forest, New York, N. Y. App. filed Feb. 3, 1916. Audion detector, amplifier or generator.

1,365,168. SPARK INTENSIFIER; Otto A. Gerdes and Emil Guth, Blue Island, Ill. App. filed May 26, 1920. For use upon old or worn spark plugs.

1,365,170. INDUCTANCE-COIL MOUNTING; Robert F. Gowen, New York, N. Y. App. filed Aug. 20, 1919. For coupling purposes.

1,365,186. ELECTRIC IRON; Jose A. Oca Balda, Bridgeport, Conn. App. filed May 16, 1919. Time-controlled switch and indicator.

1,365,193. ELECTRIC CUT-OUT BOX; Roscoe Ratcliffe, Plainville, Conn. App. filed Nov. 17, 1919. Detachable section.

1,365,198. METHOD OF AND APPARATUS FOR ELECTRICALLY WELDING TUBING; Frank L. Sessions, Lakewood, Ohio. App. filed March 24, 1919. Electrically welding lap-seam or close-butted-seam tubing.

1,365,199. METHOD OF AND APPARATUS FOR ELECTRIC WELDING; Frank L. Sessions, Lakewood, Ohio. App. filed Sept. 27, 1919. For welding lap-seam or close-butted-seam tubing.

1,365,201. TROLLEY; Earl W. Sinnett, Grand Rapids, Mich. App. filed Oct. 27, 1920. Slide contact to replace trolley wheel.

1,365,224. ARMATURE CORE; John B. Bushnell, Berkeley, Cal. App. filed Nov. 23, 1918. Magneto.

1,365,225. MAGNETO; John B. Bushnell, Berkeley, Cal. App. filed May 24, 1919. Impulse starter.

1,365,231. PRINTING-TELEGRAPH SYSTEM; Amos F. Dixon, Newark, N. J. App. filed Feb. 14, 1918. For keeping several stations in synchronism.

1,365,268. TELEPHONE-TRANSMITTER MOUTHPIECE; Clarence E. O. Olliffe, Leichhardt, New South Wales, Australia. App. filed Aug. 21, 1920. Germicidal disk.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

Middle Atlantic States

BROOKLYN, N. Y.—Bids will be received at the office of J. H. Delaney, commissioner of transit construction, 49 Lafayette Street, New York City, until Feb. 1 for installing an electric motor-driven drainage pump in the Fourteenth Street eastern district subway at Meserole Street and Bushwick Avenue.

BROOKLYN, N. Y.—The Nassau & Suffolk Lighting Company, 149 Broadway, New York City, has arranged for an issue of $436,000 in bonds for proposed extensions and general expansion.

NEW YORK, N. Y.—Bids will be received by J. W. Brannan, president of the Board of Trustees of Bellevue Hospital, at the office of the general medical superintendent, 415 East Twenty-sixth Street, until Feb. 4 for the installation of a complete fire-alarm system in the engineer's office, main office, old buildings and pavilions I, K, L and M.

SALEM, N. Y.—F. C. Lovejoy has applied to the Public Service Commission for permission to construct an electric plant at this place.

MILLVILLE, N. J.—The Millville Light & Power Company contemplates the erection of an addition to its power plant to cost about $500,000. S. J. Franklin, High Street, is engineer.

PERTH AMBOY, N. J.—Plans have been approved by the Board of Aldermen for the installation of a new ornamental street-lighting system on Madison Avenue from Market Street to New Brunswick Avenue. J. B. Franke is city electrician.

PHILADELPHIA, PA.—Bids will be received by W. S. Twining, director of the department of city transit, twelfth floor, 1211 Chestnut Street, until Feb. 8 for furnishing and installing electric lighting and power wiring for the car inspection shop and for lighting the yard at Bridge and Penn Streets, also an electric lighting system for Bridge Street Station and the trainmen's building at Frankford and Bustleton Avenues.

PETERSBURG, VA.—The Chesterfield Manufacturing Company contemplates the erection of an electric power plant to furnish light and power for present mill and for larger mill to be constructed later. J. F. Taylor is president.

North Central States

DETROIT, MICH.—The Public Lighting Commission, care of A. L. Jones, acting president, 138 East Atwater Street, contemplates the erection of a new power plant of 25,000 kw. to supply electric power for municipally owned street cars, fire department's high-pressure pumping station, and lighting streets and public buildings. The cost of the plant is estimated at about $500,000.

SPRINGFORT, MICH.—The city officials are considering entering contract with the Consumers' Power Company, Jackson, to supply energy for light and power. This plan would include the erection of a transmission line to Albion at a cost of about $22,000.

WAKEFIELD, MICH.—Improvements and additions to the street-lighting system, to cost about $5,504, are under consideration. W. Jacobson is city clerk.

CANTON, OHIO.—The municipal water commission is considering the erection of a central power plant for the operation of the pumping stations and to furnish light for city buildings and streets. The cost of the plant is estimated at $140,000. J. A. Buell is in charge.

MIDDLETOWN, OHIO.—Plans are under way for the installation of an ornamental street-lighting system. Mr. Morrison is city engineer.

MONROE, OHIO.—The County Commissioners at Eaton have granted permission

to D. Wolford to establish and maintain an electric transmission line in Monroe Township to provide for light and power.

ZANESVILLE, OHIO.—E. R. Meyer, electrical counsel of Zanesville, and R. E. McClure of the Ohio Electric Company, Springfield, are considering improvements, including a new power plant, extension to the street-lighting system, etc.

WAUKEEGAN, ILL.—The City Council has passed an ordinance providing for the installation of an ornamental street-lighting system at a cost of about $53,000.

ASHLAND, WIS.—The city officials contemplate the installation of an ornamental street-lighting system. W. C. Morris is city clerk.

MADISON, WIS.—Mayor L. M. Kittleson will have plans investigated for the erection of a municipal electric plant.

MANITOWOC, WIS.—The Oslo Power & Light Company, 826 South Eighth Street, plans to enlarge its plant, extend its wires, etc. H. Groth is in charge.

MERRILL, WIS.—The City Council has authorized the installation of an ornamental street-lighting system to cost about $30,000.

OCONOMOWOC, WIS.—The city officials contemplate the installation of a switchboard in the municipal light plant and in an outside substation. T. S. Johnson is city clerk.

DARWIN, MINN.—The village officials contemplate the installation of an electric lighting system. Energy will be obtained from the municipal plant at Litchfield. F. O. Holm is village clerk of Litchfield.

GRAND RAPIDS, MINN.—The city officials contemplate the erection of a municipal power plant at the government dam. F. A. McVicar is city clerk.

MINNEAPOLIS, MINN.—The Hennepin County Sanitorium Commission proposes to issue bonds to the amount of $1,500,000 for the erection of a sanitarium, including a power plant to cost about $210,000. E. C. Gale is a member of the commission.

ESTHERVILLE, IOWA.—The Emmet County Light & Power Company has petitioned the board of supervisors for permission to construct a transmission line along the public highways.

TROY MILLS, IOWA.—The Natural Research Development Company has plans under way for water-works improvements and a power house to cost about $50,000. Holland, Ackerman & Holland, 122 North Fourth Street, Ann Arbor, Mich., are engineers.

ST. LOUIS, MO.—It is reported that the Kansas City, Clay County & St. Joseph Railroad Company, 530 Railway Exchange, Kansas City, has plans under way for the construction of an electric railway line from St. Louis to Kansas City, a distance of about 250 miles.

VELVA, N. D.—The Dakota Engineering & Construction Company, Valley City, is considering the establishment of an electric generating plant near this place.

PHILIP, S. D.—C. H. Holcomb recently purchased a light and power plant and contemplates improvements.

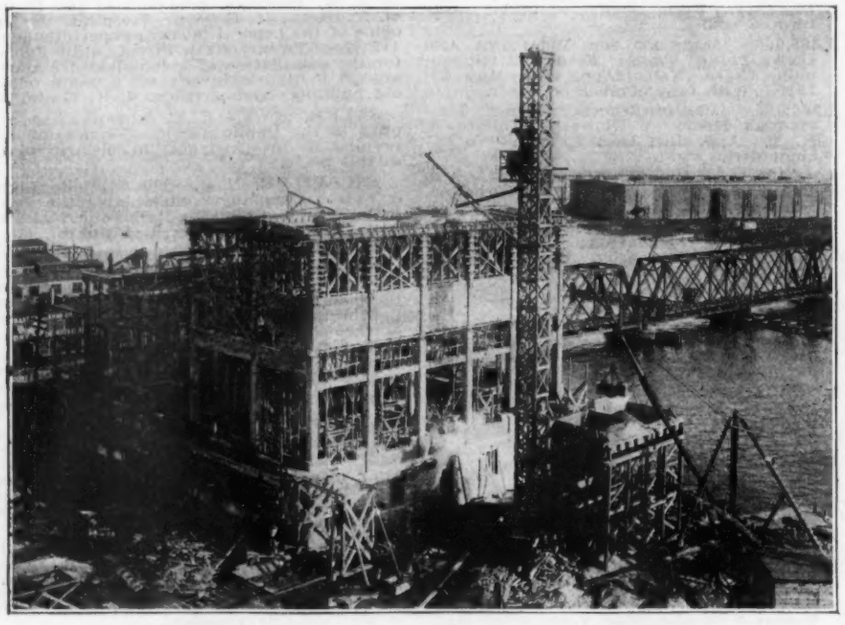
LEAVENWORTH, KAN.—Petitions have been circulated requesting the city officials to call an election for the purpose of submitting to the voters a proposition to issue bonds for the erection of a new electric light plant.

Southern States

CHARLOTTE, N. C.—The Southern Power Company, Church Street, contemplates the erection of a hydro-electric plant on the Catawba River to develop 35,000 hp. W. S. Lee is vice-president and engineer.

FAYETTEVILLE, N. C.—The Cumberland Railway & Power Company, Raleigh, plans to extend its street-railway lines in Fayetteville to Camp Bragg, a distance of 9 miles, at a cost of about $100,000. J. R. Baggett is receiver of the company.

FERNANDINA, FLA.—The city officials contemplate improvements to the municipal electric light and water plant.



POWER HOUSE CONSTRUCTED OF REINFORCED CONCRETE, OSHKOSH (WIS.) GAS LIGHT COMPANY

GERMANTOWN, TENN.—The town officials plan to issue bonds for the installation of an electric light and water plant. Gaines & Carlisle, 206 Falls Building, Memphis, are architects and engineers.

MEMPHIS, TENN.—The city and county officials of Memphis contemplate the erection of a municipal market and auditorium to cost about $2,000,000. Plans include the installation of an electric power plant. Bids will be received for construction work on March 1 by C. O. Pfeil and G. Awsumb, architects, 1403 Union and Planters' Building.

GADSDEN, ALA.—The Public Service Commission has granted permission to the Alabama Power Company, Birmingham, to erect a transmission line from this place to a point on the Georgia state line to connect with the line of the Georgia Railway & Power Company. T. W. Martin is president.

POTEAU, OKLA.—The Poteau Telephone Company plans to erect a two-story, 25-ft. x 80-ft. addition, install switchboard and replace wires with cables. The cost is estimated at about $200,000.

TISHOMINGO, OKLA.—The city officials contemplate the extension of transmission lines from this place to Milburn, a distance of 9 miles.

HARLINGTON, TEX.—Bonds to the amount of $60,000 have been voted for the installation of municipal light, water and sewer systems.

Pacific and Mountain States

CHELAN FALLS, WASH.—The Chelan Falls Power Company is planning to enlarge its facilities by installing a 12,500-hp. plant here. G. D. Brown is president.

PE ELL, WASH.—The Pe Ell Light & Power Company has been incorporated with a capital of $10,000 to generate electricity and handle electrical supplies.

ARROWHEADS SPRINGS, CAL.—Plans have been prepared for the erection of a power house and portable buildings to cost about $60,000, at the Public Health Hospital at this place.

CALEXICO, CAL.—The City Council is considering the installation of a municipal light plant. M. L. Parcels and A. C. Baskin were appointed to investigate the cost, etc.

LOS ANGELES, CAL.—The city engineer has been instructed to prepare ordinance providing for the installation of an ornamental street-lighting system on Ogden Street between Sunset and Hollywood Boulevards.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Corporation plans to expend between $4,000,000 and $5,000,000 to enlarge production plants and extend its distribution system. The company has applied to the Railroad Commission for permission to issue $1,000,000 toward the development of this work. Estimates are now being prepared by engineers.

MONTAGUE, CAL.—R. E. Swigart, trustee of the Klamath-Shasta Valley Irrigation project at this place, has been granted permission to divert 1,600,000 acre-ft. of water from the Klamath River for storage purposes. Plans also include the development of 110,000 hp.

OLANCHA, CAL.—The Public Service Commission has authorized the erection of a transmission line from the municipal power plant at the Haiwee reservoir to the town of Darwin. The cost is estimated at between $75,000 and $80,000.

SANTA BARBARA, CAL.—An appropriation of $130,000 for a new lighthouse at this place has been recommended by the Rivers and Harbors Committee of Congress and indorsed by the Navy Department. Plans also include the erection of a wireless station and the installation of new island lights.

LEVAN, UTAH.—The Town Council contemplates an election soon for the purpose of submitting to the voters a proposition to issue bonds for the erection of a municipal light plant.

IDAHO FALLS, IDAHO.—The City Council will be petitioned to take steps in securing a lighting system for C Street.

ST. MARIES, IDAHO.—The Washington Water Power Company, Spokane, Wash., has applied to the Public Utilities Commission for permission to construct a transmission line from the Kootenai-Benewah county line along the St. Joe River to the limits of this city.

SELIGMAN, ARIZ.—E. L. Beyard of this place has applied to the Federal Power Commission for permission to develop 480,000 hp. on the Colorado River, Mojave County. This project will include the electrification of 500 miles of the Atchison, Topeka & Sante Fé Railway system and the irrigation of 500,000 acres of desert land.

LARAMIE, WYO.—The Midwest Refining Company contemplates the installation of one 500-kva., 2,300-volt, 60-cycle, steam-driven turbine, three 125-hp. motors for water pumping and one 100-hp. motor for boiler feed. J. F. Cullen is superintendent.

Canada

HALIFAX, N. S.—The Nova Scotia Power Commission plans to take over the power plant in operation at the Mushamush River, which supplies Lunenburg, and contemplates increasing its capacity in order to supply several adjoining towns. The commission also proposes to improve some power plants now in operation. A power project on the East River, Sheet Harbor, allowing a development of 25,000 hp., is under consideration.

LONDON, ONT.—Bids will be received by E. V. Buchanan, general manager of the Utilities Board, about March 1 for the erection of a substation on Cabell Street to cost about $50,000.

MONTREAL, QUE.—The Shipman Electric Engineering Company, 26 St. George Street, plans to purchase one 7½-hp., 110-volt Wagner or Century single-phase motor; one 350-kva. three-phase, 60-cycle, 600-volt synchronous motor, and one 150-kw., 220-volt to 110-volt, three-wire, direct-current generator.